THE

ELECTRICAL REVIEW.

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MOTOR CARS.

MOTOR car day has come and gone. The 14th of November is associated in all minds with the annual meteoric shower which attains its maximum about every 33 years, and the passage of the motor cars to Brighton on the 14th was not unfittingly dated, for the display was a trifle meteoric. Certain of the cars, if report be true, displayed a meteor-like speed; mud was thrown in catherine-wheel fashion to a liberal extent, and they left a trail behind them—not fiery, it may be, but certainly very olfactory. An enormous amount of drivel has been talked, the daily Press has brought forward its mouse, Lord Winchelsea has tootled his own horn, a new motor car company was put before the public on Monday on the strength of Saturday's performance, and a new Heilmann has arisen, if we may judge a novel proposition to be somewhat on Heilmann's lines, as to which more anon.

What is the first thing we notice? That no electrical carriage got through to Brighton. All the cars arriving were petroleum cars, and we may, therefore, spare some space to discuss the electrical cab, which forms the subject of the prospectus issued to the public on Monday. The idea is to use accumulator-driven cabs in London, itself a fairly big field, and to leave the country to be covered by petroleum and steam. The propositions put forward are to use two sets of accumulators to each cab, to have depôts all over London for changing purposes, and to arrange with the electric light companies to supply current. The cells are, of course, of special patented design. We feel tempted to apply the word blessed to this word special, which does duty, like Mesopotamia, in all these prospectuses. But surely the accumulator must get more than enough knocking about, and we fear that not sufficient consideration has been given to the depreciation to which they must inevitably be subjected?

The company's expert opinion places the cost of a cab at £150, to which is added £100 for two sets of accumulators, each equal to 40 miles running, £52 is allowed for annual depreciation, of which £10 alone is set down for the cells, as per the manufacturers quoted 10 per cent. Now, manufacturers have absolutely no experience in cab running, and are not likely to stick to the 10 per cent. if they find it to be exceeded. Even when the batteries are stationary, and used only for lighting work, 10 per cent. is barely enough, and it is absurd to think that for cab work, and its attendant shaking, changing and other causes of shock, cells can be run for 10 per cent. depreciation. Indeed, the cells must be more than ordinarily slight on weight account alone, and will be all the more liable thereby to rapid deterioration.

On their estimate the daily cost is 2s. 10½d., and to this is added 2s. 9d. for electrical energy at 1½d. per unit to the amount of 22 B.O.T. units per diem., or enough to run a cab 50 miles. This is equal to 30 H.P. hours, or, say, for eight hours per day, nearly 4 H.P. It is very doubtful if

power can be bought at the present moment for 1½d. per unit. However, here we have energy stated to cost 2s. 9d. per day. It is certain that a motor cab will not make any greater speed than a horse cab. What does it cost to keep a horse? Probably much less than 2s. 9d. per day in food at the prices at which large purchasers can secure fodder. A horse will run for five years even on bus work, and a good deal more in a cab, and when used up will fetch a quite considerable percentage of its original cost; however, we digress. We would not throw cold water on electric traction in any form, but at the same time we cannot think that the testimony of the experts is worth much. They seem to have been far too ready to accept statements as proved facts, and to have paid no really serious attention to horse costs to induce reliance to be placed on their comparisons. The electrical engineers who push electrical car schemes never seem to think anything of horse cost, either as to its life, its food cost, or its scrap value. Neither do they vouchsafe any information as to the electrical losses between dynamo and cells, between cells and motor, or between motor and car axle. The life of flimsy cells is short, their first cost is great, and the current costs are likely to exceed the quoted 2s. 9d. per day, even on the improbable 1½d. per unit basis—improbable not simply on the face of it, but in face of possibly 25 to 50 per cent. of losses between dynamo and car axle.

But the petroleum car people are no better in their talk than are the electrical men, though a little further advanced in their performances. One L. Hollier, calculates, according to the *Standard*, that in many cases two-thirds of the power was wasted by the heavy roads. Now, is not this ridiculous? Are roads to be kept to billiard table smoothness and dryness to suit the motor any more than they have suited the horse. The wasted (!) power was used to overcome the resistance which has always had to be overcome by the horse. The pity of it is that the motor car business up to date has been in the hands, very largely, of questionable individuals, and when the public becomes alive to this fact, we fear their "methods" will "gie the infant car a shog," from which, like the set back to the electrical industry, it will be slow to recover.

Mr. Alfred J. Allen, who last week made the proposal we have alluded to previously—which, however, had previously been suggested in our pages some months ago—as similar to Heilmann's for the locomotive, suggests a combination of electrical car and petroleum engine. He would have a kind of double vehicle, one, the ordinary one carrying an electromotor, the other, a sort of tender, carrying an oil engine and dynamo. A few cells on the main vehicle would provide a store for hills. By this combination he could use a small oil motor running continuously, and yet he would be able to mount hills, and store energy when running down hill or at rest. The vibration of the engine would not be felt, and there would be none of the difficulty of starting, for, once started, the oil motor would run all day, storing such energy as was not used. There is something in the idea, though it strikes us as more applicable to goods' vans than to pleasure vehicles, on account of the complication or oddity of the tender. For parcel delivery vans the combination would be, perhaps, most suitable, for such vans are always stopping and starting, and yet the engine could continue to run at maximum effect, instead of as now, running light at great waste of oil. More may yet be heard of this idea. Taking a general view of the motor car to-day existent, we may say, much as we regret it, that the electrical car is nowhere, and in face of the as yet unsatisfactory nature of the petroleum cars, electricity must be a very bad nowhere indeed, for the run of Saturday was only a success in a sense. It was a mere promoters' bubble show, and it showed that, of some 30 cars, only about 11 turned up at Brighton before 6 o'clock, having started at 10.30 from London. The whole thing was engineered to secure the public, and when the public has been duly caught, the bulk of the men so prominent on Saturday will be as innocent as a judge of all connection with motor cars, the future of which will lie with the genuine business man, whose duty it will no doubt soon become to work upon and improve the motor car, until it is a really practical and presentable machine. In the first place the master mind is wanted which shall originate a car in place of Bowdlerising a horse car for the purpose of a motor car. All the existing cars are altogether too suggestive of the missing horse. They have no suggestion of originality of design, and have as a consequence the oddest appearance when travelling.

One thing we must not forget. The two-wheeled vehicle, our favourite hansom, will disappear when the horse goes. No motor vehicle can have less than three wheels, unless it be of the bicycle type, which could never do for cab work. Thus the motor cab must have, say, four wheels. It must carry also a dead cargo of cells, equal to, at least, two ordinary passengers, and its weight therefore will be very considerable. We are very doubtful about petroleum cars for City use, for reasons previously put forward in respect of the inflammable fluid they employ, and quite apart from the necessity of deodorising their exhaust. This is perhaps possible; it is at least needed, and badly needed. But with all its present disadvantages motor cars have come to stay, and it behoves electrical engineers to seriously and conscientiously study the question, in hopes of some day finding the requisite and proper electric vehicle, as distinguished from the mere car of the promoting "Juggernaut," whose pathway is strewn with the wasted gold of a confiding and credulous public.

Consulting engineers should hesitate to endanger their reputations by giving opinions which are published to the world, and based, not upon their own experience and knowledge, but on data placed before them by interested parties. To an unsullied reputation, however, there is none too much importance attached in these days of high pressure; 'tis true, 'tis pity; pity 'tis, 'tis true!

LONG DISTANCE AND HEAVY DUTY ELECTRIC RAILWAYS.

In America, several large railroads, including the Pennsylvania, have built roads of 10 to 20 miles in length as an experiment with electric traction, but none of them, says Mr. Darlington in a recent paper before the Pennsylvania Street Railway Association, have been convinced of the advisability of adopting electricity for their entire systems. This is not prejudice so much as an absence of sufficient proofs of the commercial and practical success of electric traction for their purposes. Mr. Darlington says that so far

as the motor alone is concerned, there can be no doubt, for it can move a car faster than steam; it can pull heavier loads, being supplied with power from an outside and unlimited source; it can surmount grades and reduce expenses, and what more can be asked? The whole question, then, resolves itself into one of long distance transmission, and the satisfactory solution of this problem is what should now be attempted or proved. Alternating currents are looked on by some as the only possible means of solution, yet devices are being continually added that tend to make direct current more and more of a success over long distances. Ultimately the writer of the paper believes we shall possess the ideal alternating current, but by this he means some induction system without any actual material means of conveyance of current to the moving car, but unless very soon developed, the direct current will be firmly established. Indeed, but for the financial depression of the last two years, there would have been already a considerable adoption of electric working, and in five years' time he anticipates a large amount of work will have been effected.

Looking at the question from the point of view of the tramway man, he points out to his audience that they may soon expect competition in their own motive power from the very steam railroads whose tracks they have themselves paralleled with their lighter electrical lines, and they will have to compete with frequent service at a high speed on safe and heavy roads. He points out that at least 75 per cent. of the electric lines in Pennsylvania are paying too much for their power at the car axle, and few roads are dividend payers; many are in the hands of the receiver. All records of expenses ought to be based on the same unit, and this unit is properly the car mile. The manager should have all his statistics brought down to a car mile basis, because his object is to run cars so many miles. Receipts being also put upon the same unit, a manager may know at once how he stands, and can readily ascertain the value of an improvement, and the use of this one unit would enable comparisons of real value to be made between various roads. At present, the reports of different roads vary to such an extent that comparisons are impossible.

The difficulty with this single unit system comes in with respect to items which vary. Coal, for example, if run into general account for the purpose of giving total cost per car mile is a very misleading element, and it would be as well if, for the purposes of interchangeable comparison, fuel were brought into account at an assumed price per ton, no matter what its actual cost. The accounts would be duplicate; there would be actual cost per car mile and car mile cost on a basis of fuel at a given price. Without such a fictitious system for comparison, the efficiencies of different roads would not be arrived at. Road A, burning $10 fuel, might show a greater car mile cost than road B, burning $3 coal, and yet road A might be the more cheaply worked road, so far as real efficiency counted. The commercial element takes account of £ s. d., and very properly so; but any commercial man, who thinks he is clever when he puffs himself out and proclaims his habit of measuring all things by £ s. d., only shows his ignorance when he attempts to get at engineering results on the sheer cost basis, because the steam engine cares nothing for costs of fuel or water, and will eat up about as much fuel at one price as at another. The electric road competes to-day with steam very largely, because it runs cars at short intervals, and no time-table need be consulted, and moreover, there is a freedom from the cinders, which, more than in England, are a special feature of steam railroads. As regards speed, if a speed of 72 miles an hour (? at the rate of) can be obtained on a road only seven miles long for three miles, as done on the road of the P.R.R. in New Jersey, should not 80 miles be equally easy to obtain on such a road bed as the main line of the P.R.R. between New York and Philadelphia, a road which compares with those of England in its stone ballasting and general solidity. Mr. Darlington advocates motor cars rather than independent locomotives, for the reason of the unnecessary weight of the latter. With a motor baggage car, for example, practically half the weight of present steam hauled trains would be avoided. Electricity is far ahead of any other system of traction, in that there is nothing to be carried in the shape of air tanks, oil, coil, water, or gas tanks, and an unlimited power is thus available as required. In conclusion, he warns his hearers that the steam railroad men will bring experience of great value to bear on the question of the electric system when they take it up, and their competition will be very keen.

Science and Engineering.

The recent address of the President of the American Society of Civil Engineers, spoken at the Convention, dealt with the relation of science to engineering in an admirable manner. The President is Mr. T. C. Clarke, one of America's oldest and most respected engineers. Mr. Clarke truly says that the priests of Egypt were the earliest engineers of whom we have record. Their masonry work is still unsurpassed and to-day we excel only in having command of metals to a greater extent than the Egyptians. But all professions, law, medicine, architecture, as well as engineering, have been developed from the clerical profession. This of course has arisen because the clergy alone were educated until quite recent years, and to this day there is a feeling that a parson is necessarily a well-educated man, though we know well enough that he often falls very short indeed. Civil engineering as understood to-day is the youngest of the professions, simply because, being based on the use of nature's laws the profession could only arise when the laws had been studied and learned, and the science of to-day may be said to have arisen with Newton's discovery of gravity. In Mr. Clarke's own day have been discovered the evolution of living forms by Darwin, modern geology by Lyell, and the many discoveries by Helmholtz, Joule, Faraday, and others, culminating in the discovery of the conservation of energy, which is itself good enough to blast such things as Keely motors for ever. The spectroscope, a purely scientific instrument, has added immensely to the knowledge of the distant stars and enabled us even to measure their velocities while proving the universality of matter and its identity throughout space. Synthetic chemistry again is new, and the new study of the microbes is likely to have its effect on engineering, just as the spectroscope has been applied to determine the constituents of flame in steel manufacture. The latest of all the sciences is that of electricity, latest that is in its practical applications on a large scale; and the newest of all sciences, aviation, may mark the close of the current century or usher in the early years of the next. Engineering in all its branches is closely related to science. Engineers may not all be scientific men, or their particular branch of work may not appear to have an immediate scientific connection. Yet whatever the branch, its root is somewhere in scientific soil. Mr. Clarke considers that no man can be a great engineer unless he have what we may term the scientific habit of mind, and he looks to the technical schools to give this to the young engineer, and speaks in a hopeful tone of the results so far obtained, and is of opinion that the civil engineers of America ought to aim at securing the status accorded them in England and Europe generally as chief directors of great undertakings, commanding the services of many other various professions and crafts. When science and experience are united in one person, we have, says the President, seen the evolution of the engineer from the craftsman, or rather, to quote more correctly, of a craft into a profession.

McDONALD'S BATTERY AND ITS TESTS.

In a somewhat lengthy note we referred last week to the McDonald Patent Electro-Generator and Storage (!) Battery. We had dealt with this simple element, in which we found no trace of novelty, in two issues of February, 1895, and were under the impression that we should have no further occasion to again call attention to a matter which, to technical men, has no real importance; but the letter we received from Mr. Urquhart, the secretary and solicitor to the syndicate which controls the patent for this galvanic element, merely a combination of well-known materials, renders it imperative that we should now enter fully into the question of the tests to which he was good enough to call our attention.

First of all we wish to state that the description and sketch of the McDonald cell, which appeared in the Review for February 22nd, 1895, tallies exactly with that in the descriptive pamphlet issued by the syndicate—price 4d.—and in the patent specification itself. The provisional portion of this we will quote, the italics being our own:—

"Our invention relates to electric or galvanic batteries, and *it has for its object to improve their construction.*

"In carrying out our invention we fill the porous cell with, by preference, salt water, and we place in this liquid one or more pieces or plates of zinc as usual.

"The outer jar is filled with copper sulphate in solution, or in crystals, and with cinders, coke, or like cheap porous and absorbent material.

"A copper spiral is also placed in the jar, preferably to be in contact with the pieces of coke or the cinders, and to surround the porous cell.

"As a result of the action set up in the battery, the coke or the like becomes plated or coated with a thin film of copper.

"The coke or the like absorbs the gases evolved, *and as a consequence, no fumes are emitted from the battery.* The battery has the merits of simplicity, cheapness and great power.

"In practice, we have found that a small cell, 3 inches square, gives 4 amperes at 2 *volts pressure* constantly for over 24 hours at a stretch.

"It is to be understood that instead of the salt water we may use *any other well known and cheap liquid*, and also, if desired, the sulphate of copper may be used in crystals."

It will be observed that this specification has merely the object of improving the construction of galvanic batteries, and does not disclose any new type of element, or make mention of any hitherto unknown combination of electrodes or electrolytes; how and where the fumes could possibly arise is best known to the inventors, who carefully omit from the *complete* specification their discovery of 2 volts per cell from a zinc-copper, or, to begin with, zinc-carbon couple in saline and cuprous solutions. They also substitute for "any other well known and cheap liquid," "any other *suitable* and well known fluids." Polarisation is said *to be prevented*, but how much reliance is to be placed on this statement, the allusions to the tests which will be made later on will demonstrate.

This, then, is the sum total of a battery, the invention (?) of two brothers, one of whom, aged 19, "studied in the leading technical colleges of Glasgow (*pace* Prof. Andrew Jamieson), and obtained a thorough knowledge of chemistry and *all branches* of electrical science."

The *thorough* knowledge obtained by the youth in question as to how he could have his cake and eat it too, can be gauged by the following extract from the pamphlet which follows a brief statement that hitherto the best primary batteries have been found quite inadequate for all purposes requiring any considerable current of electricity:—"For a long time Messrs. McDonald had been of opinion that a primary battery might be constructed so as to generate and *store electricity within itself* (the italics, again, are ours) to such an extent as to produce high motor power without resource to a dynamo, and they accordingly applied their minds to its construction."

Following this, the pamphleteer proceeds:—"Hitherto, apart from the important question of expense, several strong and insurmountable objections have militated against the extended use of primary batteries—*e.g.*, insufficient motor power and polarisation."

"As to insufficient power.—A glance at the reports of the tests which are contained in the appendix, will show that a Daniell battery, which is the only primary battery in practical use which can yield a constant current, can only generate a fractional part of the current generated by a McDonald battery of the same size, and is entirely insufficient for all purposes requiring a strong current."

"As to polarisation.—This has hitherto been the great enemy of chemical generators. The gases which are given off cling to the surface of the negative plate used in a chemical cell, with the result of immediately stopping the action of the cell. Many scientific men have endeavoured to overcome this defect by using expensive acids, and by other means, but without success. Messrs. McDonald, however, by this invention have done so, and that successfully. After prolonged investigations and innumerable experiments extending over a period of years [one youth has arrived at the mature age of 19 while his brother is 22] they discovered that by using a porous negative element which would absorb the gases instead of allowing them to clog the surface of the plates, polarisation could be wholly and effectually prevented. Their aim was then to discover such a porous material as would be cheap and easily obtained, and this they found in the cinders of common coal." The invention (?) of the wire spiral as a "new form of connection" appears to have been anticipated by A. R. Bennett in 1882 (*see* Electrical Review, February 18th), and by Jablochkoff later, who used "a wire helix to hold the coke and to conduct to the external circuit."

The battery, we are told, can be used for purposes unlimited; but of these we only select a few that anyone who has handled Daniell cells would be likely to employ them for!! Supplying motor power to yachts, vessels of *all sizes*, auto-cars and horseless carriages, turning lathes, drilling machines, pumps, domestic electric lighting, and lighthouses!!

We stated in last week's "Note" how the McDonald battery "both generates and accumulates the electricity itself," and we will now turn to that part of the catalogue which gives us information as to the number and size of cells necessary for their practical application to different purposes. Look at the following table, calculated for autocars and motor cycles:—

Brake H.P.	Size of cell.	No. of cells.	Weight of cell fully charged.	Volts.	Amperes.	Capacity in ampere-hours.
¼	8″ × 4″ diam.	9	4½ lbs.	10	12	60
¼	8″ × 4″ „	18	4½ „	20	12	60
½	12″ × 4″ „	20	7½ „	23	18	100
1	12″ × 6″ „	24	14 „	27	30	250
2	12″ × 9″ „	24	30 „	27	60	400

It will be noticed that the E.H.P. is so slightly above the actual B.H.P. required, that some phenomenal kind of electro-motor must be used to transform electrical energy into mechanical power with such a trifling percentage as is here allowed for loss. Under "classification of cells" (page 13 of the pamphlet) we read:—"No. 3 cell. Price, 10s.; postage, 1s. 6d. extra. Capacity, 250 ampere-hours. Discharge up to 25 amperes. This cell is 5-pint size, and is recommended for heavy motor work, from ¼ H.P. upwards."

Now, anyone unacquainted with electrical matters, reading the above, would assume that one cell would be all he required for ¼ H.P., and it is only when we reach page 16 that we read under heading, "Battery to develop ¼ horse-power," that one requires a case containing 12 of these cells!

And further on comes the childlike and bland remark, "It will be seen from the reports and testimonials that the longer the cells are used the greater is the amperage." Put into plain English, this means that according to the number of hours the cell is giving current, oblivious of the fact that the E.M.F. may have fallen so low as to render the cell practically useless, the more will be the ampere hours, not the amperage, and here we take leave of the matter till next week, when the tests (!) will receive our most careful consideration.

(*To be continued.*)

ACCUMULATORS FOR TRACTION WORK.

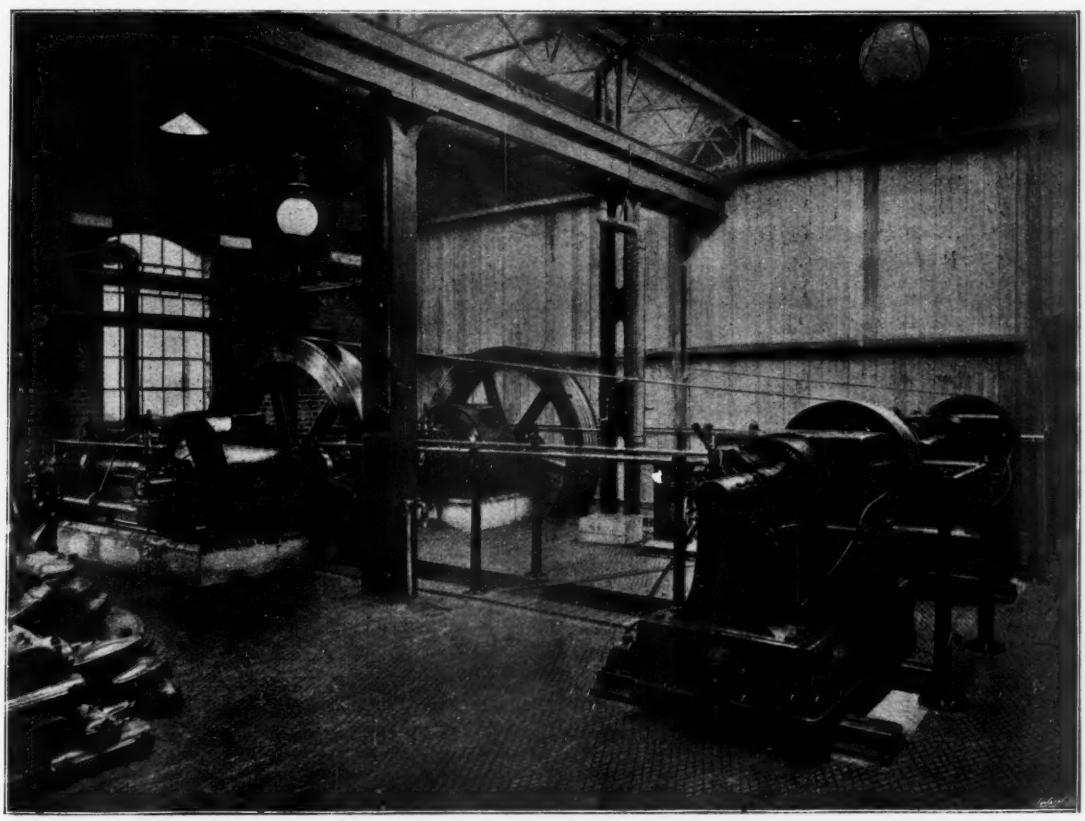
Many practical men have for a long time held that the proper place for accumulators in traction work is not upon the cars at all, but in the power house or sub-stations for storage and regulating purposes; and it would seem that for such uses the accumulator offers such great benefits and economies as the skilled engineer is only too glad to possess.

A typical instance of this may be quoted from one of the Philadelphia tramway lines, operated by the Union Traction Company as part of its huge network. On the line in question, a feeder has for some time been in use for a distance of 11 miles, and with the increase of traffic the current required has become far more than the feeder was ever designed to carry, involving a serious drop in voltage at the far end with a variation in pressure of as much as 50 per cent. Still further extensions of the line and traffic being proposed, and, indeed, becoming necessary, the company came face to face with the problem of coping with this increase, and instead of building an expensive new power house—costly to erect and operate—an accumulator sub-station was decided upon. The feeder hitherto had been carrying from 100 to 700 amperes; the latter a serious overload. It now carries 400 amperes only all day long, the battery making up the difference and charging or discharging in accordance with the load on the feeder. According to charts published in the American electrical papers, and taken from recording instruments, the regulating powers of such an accumulator are very noticeable, the pressure remaining nearly constant at a little under 500 volts, so long as the battery remains in circuit—5 a.m. to 1 a.m. The current varies enormously in quite brief periods, as every tramway engineer is aware, the curve of amperes crossing the line between charge and discharge 50 or 60 times an hour, or, on the average, once every minute: and the ranges of current taken are equally erratic, varying between maxima either way within a couple of minutes.

It speaks well for batteries that they are able to stand this heavy work, and help to regulate the demand in so useful a fashion; it lightens the station engineer's load in every way—both literally and metaphorically—the excess load on his engines and also on his mind.

STEAM CONSUMING APPARATUS.

Our contemporary, the *Electrical Engineer*, of New York, does not pose as a comic paper but none the less it succeeds in producing matter eminently entertaining to the average Britisher. In the issue of November 4th two columns were devoted to the discussion of steam power plant under the above exceedingly suggestive title. A few months ago American lighting and power stations were considered as national asylums for the makers and sellers of leather belting, and not by any means the least instructive part of the said article is that which trots out the direct coupled plant as a modern development of American practice, whereas, notwithstanding that Edison long ago produced direct coupled plants, it was on this side of the water that the advantages of direct coupling were first fully explained and insisted on. The result is that probably neither here nor on the Continent could a single editor be found who would devote even so much as a single paragraph to the discussion of such an antidiluvian subject.



Leyton.—Gas Engines and Dynamos.

At the present moment when some of the best of English high speed engines are being elbowed out to make room for American productions, it is not altogether uninstructive that our keen cousins speak of engines of their own manufacture as "steam consuming apparatus." Why not call them "coal-eaters" right away? It is much shorter and quite as descriptive.

The writer says that the main objection urged against direct coupling was, that the shocks resulting from overloads were thrown directly on the engine without the cushioning

effect of a belt: considering that the engine drives the dynamo and not the dynamo the engine, it is difficult to see where the shock was to come from. Every reciprocating engine stops and starts twice in a revolution, and unless the dynamo can stop it more quickly than that, or automatically raise the boiler pressure, it can do nothing to shock even the most modest of steam engines.

It is pleasing to note that "none of the installations of direct-driven generators can trace any trouble to this source." After enlarging discursively on the merits of condensing engines, our author descends (a great descent for an American) to discuss efficiencies, and informs us that an engine drops off in efficiency very rapidly when it is running below its rated load. Whereas, as a matter of fact, the Corliss condensing engine which forms the principal item on the menu, scarcely falls off at all in thermal efficiency until very low loads are reached, and the frictional losses being nearly constant, the mechanical efficiency falls slowly at high loads and only rapidly at very light loads.

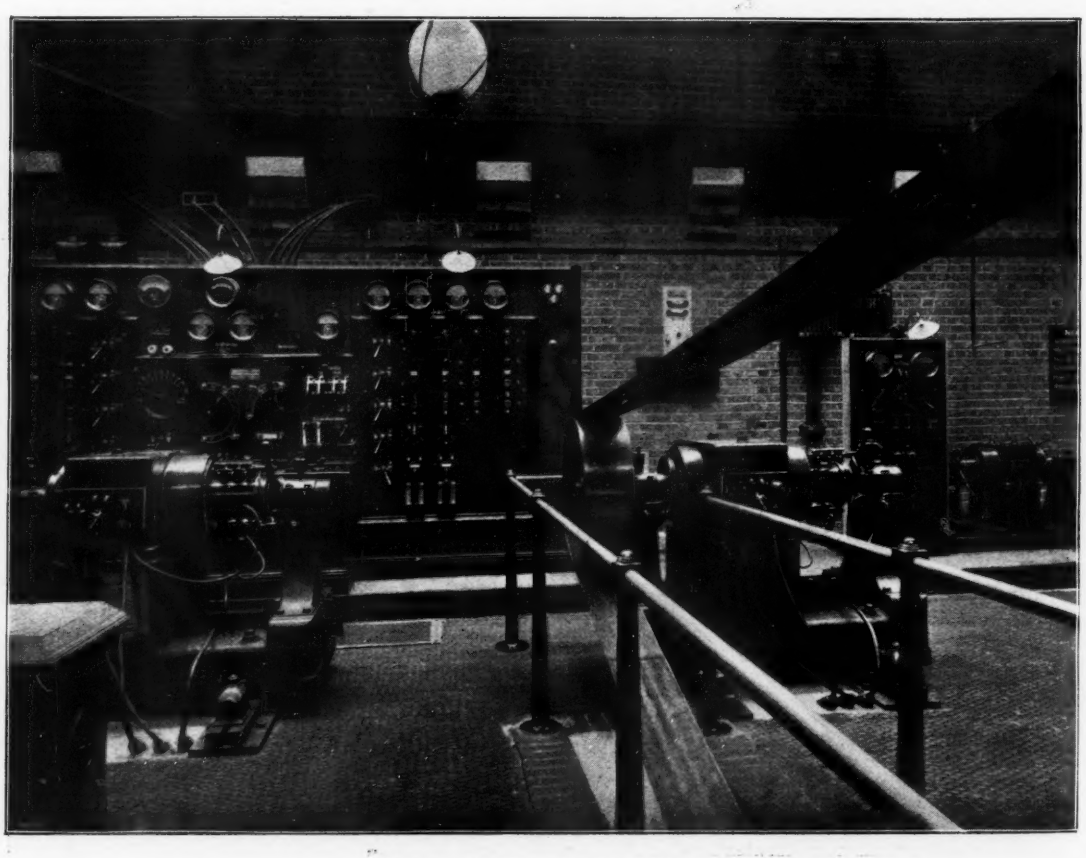
We presume our good friends of the *Electrical Engineer*, of New York, would not publish "information" of the kind unless they considered it up to date and up to the average, but if this is the average of American steam power science what advantage do we derive by importing the results into this country *duty free?* They certainly ought to pay something on entry to provide for their keep; having probably quite as good appetites as the Irish and Scandinavian emigrants, to whose entry into America, unprovided for, our friends so strongly object.

There is an opinion prevalent in the United States that the American language will ultimately become the means of intercourse between the civilised races of the World. Perhaps it may, but in any case, that end, if it be desirable, would be more rapidly achieved if some intelligent Americans would invent a few simple synonyms for their verb "to operate."

LEYTON ELECTRIC LIGHTING WORKS

When the opening of electricity works is almost a matter of every day occurrence, and when one station becomes a replica of another, it must be conceded that a visit to the works, and the consequent description, becomes somewhat wearisome. Monotony of design, however, cannot be urged against the recently completed electric lighting works of the Leyton Urban District Council. As a matter of fact, they constitute a great departure from existing practice. Primarily, the most interesting feature is the employment of gas engines, which are fed with Dowson producer gas.

The history of gas engines in public supply is not a favourable one. The instance of Coatbridge may be written down as a distinct failure, and Belfast cannot be held to be a pronounced success. In mitigation of the comparative want of success at Belfast, it may be urged that the gas, in the first instance, was too expensive; the Corporation were compelled to pay the same rates for gas for the engines as an ordinary consumer would for lighting. The case is altogether different when producer gas is employed, and although the first electric lighting works in this country where Dowson gas was employed, namely, Morecambe, never did really well, there is very little doubt that the chief cause of failure did not arise in the producer plant. If one wanted a really first-class instance of a system where electric lighting plant was used in conjunction with gas-raising plant, one could not do better than refer to the system which has been employed at the Midland Railway Company's works at Derby with conspicuous success. Mr. Langdon, in his admirable paper read before the Institution of Electrical Engineers, referred to this plant, and though he suggested on account of the newness of the plant that his figures should be accepted with reserve, they were sufficiently definite to show that there were



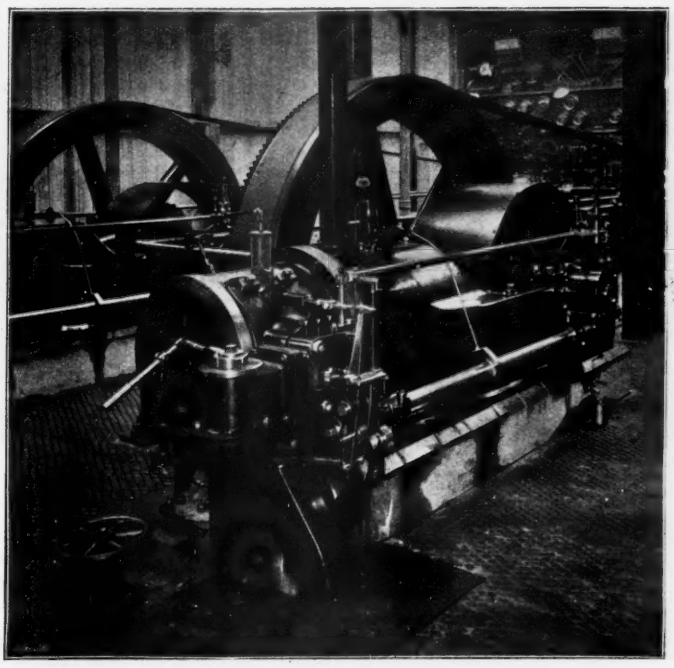
Leyton.—Switchboard and Dynamos.

great possibilities in gas producer plant. Although ordinary town gas was used in the engines on Sundays and on special occasions, the cost of arc and incandescent lighting came out at a remarkably low figure. Arc lights of 2,000 C.P. cost 1·2d. per lamp hour, while the incandescent lighting figured out at the exceptionally favourable figure of 2·3d. per unit.

It should be explained that these figures were obtained when the plant had been in use for quite a short time, and we should not be surprised to hear that later results had surpassed those which Mr. Langdon put forward at the Institution of Electrical Engineers. The system at Leyton may be briefly set forth as a low pressure three-wire, having 300 volts across the outers. In conjunction with it is a storage battery system and motor generators.

The chief point of interest, however, is the use of producer gas, and our illustrations show these distinctive features. Commencing, first, with the gas producer plant, it may be observed that behind the generating station, and in a separate building, are two gas generators. Each one is designed to make gas equivalent to 100 B.H.P., and each has a cooler made of flat steel chambers, hydraulic box and coke scrubber, and sawdust scrubber. Both sets are connected to one main leading to a gasholder, and from the outlet of the latter there is another main, with a branch to each engine. The gasholder is 20 feet in diameter, by 10 feet deep, and is provided with the usual columns, wheels, balance weights, &c. In the gas generator house there are two small vertical boilers of about 3 H.P. each, one being practically in reserve. The process of making the gas may be roughly described as follows: A fire is lighted in the generator, and as soon as there is a sufficient body of fire, a jet of steam is turned in a trumpet mouthed pipe, into which a current of air is induced by the jet of steam. The mixture of steam and air is forced into the lower part of the generator, and up through the fire; at the same time more fuel is put into the generator, and the fire is gradually built up until it is about 3 feet deep, when good gas is made, and is passed into the holder. The fuel used at Leyton is anthracite from South Wales; but we understand that in other places small coke is used when it happens to be cheaper than anthracite. We shall refer later on to tests that have been carried out on the plant; but it might be remarked here that one man of the boiler fireman type is capable of looking after the whole of the gas-producer apparatus. The whole of this part of the contract has been carried out by the Dowson Economic Gas and Power Company, Limited.

Leyton.—Gas Producer Plant.



Leyton.—Gas Engine.

The gas engines, which have been supplied by Messrs. Wells Bros., and work on the Otto cycle, have many points of interest which are not usually met with. The most striking features of the engines are a very massive fly-wheel, and a system of variable speed gear, which can vary the speed of the engine from 160 to 200 revolutions while running.

The bearing surfaces are large, especially those at the large and small ends of the connecting rods. Special attention has been paid to the oiling arrangements, so that all parts could be oiled while running, even the pins in the governor arms, and all the pins carrying the rollers of the valve motion being arranged to have a continuous supply, which can be replenished while the engines are running.

Other points which are not generally used are the starting arrangements, viz., the gear for turning the engines into starting position and the relief valves for allowing them to be easily turned round past the compression stroke. The outer pedestal is also different to the usual practice, as the brasses in it are adjustable bodily, both vertically and horizontally.

The governor is driven from the crankshaft, instead of the cam shaft, an arrangement which Messrs. Wells were the first to introduce, as it was applied to their 33 brake H.P. electric lighting engines in April, 1894, and they have used it on all the engines above 12 brake H.P. since then. The advantage of this arrangement is that the governor is not affected by the slight irregularity to which the motion of the cam shaft is subject, when there is a play in the teeth of the wheels driving it; also that it runs at a higher speed than is practicable when driven from the cam shaft, and is thus quicker in action.

It will be seen that at the end of the cylinder there is a pump which is used by hand in starting the engine; this enables one to pump a compression charge into the engine. The fly-wheel of the engine, to which we have already referred, weighs 5 tons, and is provided with a special barring arrangement, worked by a winch handle. The variable speed gear is very much on the same principle as that employed in the Willans engine, and the speed is effected by altering the tension of the spring. The sketch shows the arrangement of the parts of this gear.

The spindle, A, has a crank arm keyed on to each end, one arm is operated by the governor, and the other, B, has a sliding jockey, to which the spring, S, is hooked. The screw, E, is used to move the jockey. Marks may be put on the arm corresponding to two or more speeds that may be frequently used.

Leather belting is employed to drive the dynamo, the length of the drive being 8 feet, and the belt tight. The object of reducing the speed is for the purpose of charging the battery of accumulators.

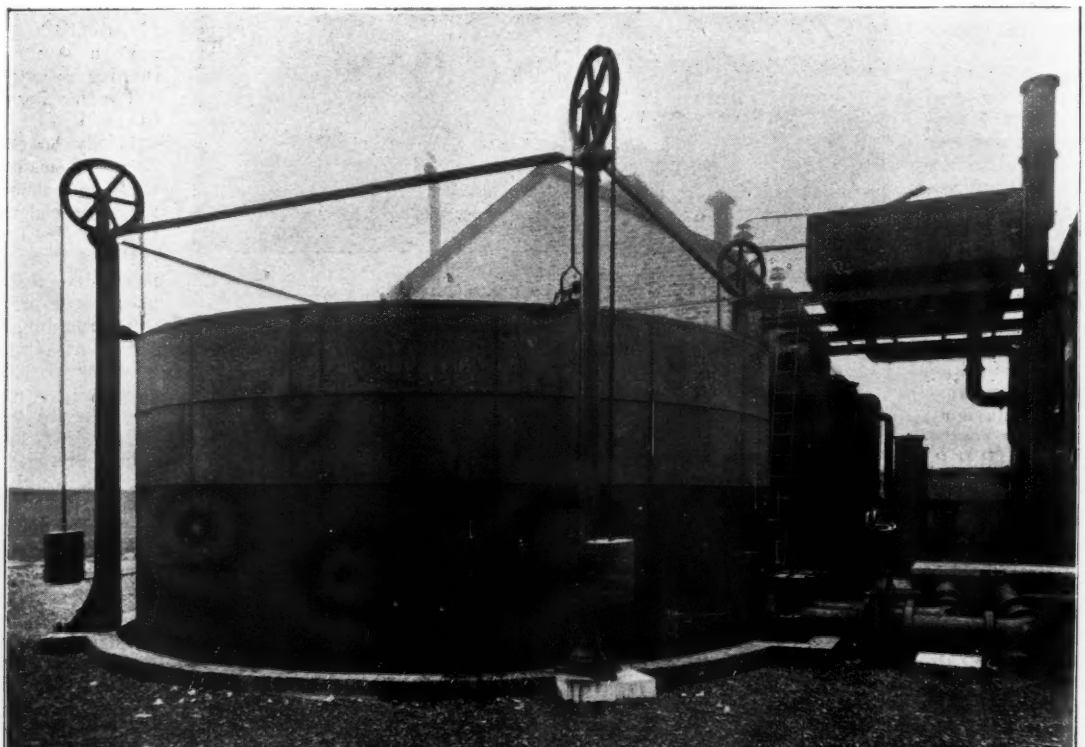
the machine being about 1,200 revolutions per minute, the magnets being excited at 150 volts from two of the mains. The exciting circuit is provided with a fuse and a switch arranged to discharge the field through a non-inductive resistance without a flash.

The switchboard is divided into three sections, the two end panels being respectively positive and negative, and the middle being practically devoted to the battery. At the present moment the two machines, four feeders and the battery, are connected to the board.

The positive main carries a fuse to give way at 70 amperes, and a 6-way starting switch. The middle conductor carries a S.P. double quick break switch and a 2-way fuse block, one fuse being connected in series with a resistance of 1½ ohms capacity. The fuses are arranged to blow at a little over 120 amperes.

The negative main is provided with a fuse to give way at 75 amperes; single-pole double quick-break switch; an ammeter, reading up to 70 amperes (placed in series with each armature).

The machines are arranged for starting from the middle



Leyton.—Arrangement of Scrubbers and Storage Plant.

There are two E.C.C. dynamos at present at work, each capable of developing an output of 42 kilowatts, or 100 amperes 350 volts at 700 revolutions per minute approximately, or 120 amperes 200 volts at 525 revolutions per minute approximately when charging batteries, the machines being separately excited off the 300-volt distributing mains. The dynamos were designed to comply with the following test:—"A six-hour run at full load to be made with each machine without any over-heating of any parts of the machine. There must be no sparking at the commutators, and the temperature of the dynamo must not in any place, or at any time, rise to more than 80° F. above that of the engine room. The same test to be applied to the dynamo when used for charging batteries and developing 120 amperes at 200 volts." In addition to the dynamos are two motor generators, one placed at the central station and the other in the basement of the new Public Offices in the High Road. Each is designed for an output of 50 amperes at 150 volts or 300 volts across the two windings, the normal speed of

and positive conductors, and when full speed is attained, the negative conductor is switched on.

In addition to the above, the switchboard is provided with all the necessary switch gear and instruments, regulating resistances, &c., as follows:—Negative: Four automatic cut-outs arranged to act when the current falls to zero, and before the reverse current rises to 15 amperes; switches and dynamo ammeters. On the positive board:—Switches, fuses, and ammeters for feeders; and on the battery board, 400-ampere battery charge and discharge switch; and one fusible cut-out.

The switchboard is provided with a special panel for testing purposes, arranged with an 11-way 150-ampere switch and resistance, and one S.P. ditto; it is also provided with the necessary shunt regulators for the generators.

Although two machines only are installed at present, the switchboard is arranged for four, having extensions in view, and we may say that the Electric Construction Corporation have now in hand the order for the extensions, comprising two new generators, and also two motor-

generators. The transformer switchboard comprises the usual switch gear.

The connections of the board and the system are shown in a diagrammatic sketch. It should be, perhaps, pointed out that the battery is connected across the positive side and the third wire; the arrangement is practically as follows:—When the batteries are running direct with the machines, they are connected to the two outers, and are practically out of use except for taking up fluctuations. During this time the transfomer is running, and is connected to the middle and the two outers, and acts as a balancer. When the machines are not running, however, and the battery is furnishing the supply, it is connected across the positive and the middle, and feeds the motor side of the transformer, the generator side of which is connected to the middle and the negative wire, keeping a pressure of 300 volts on the outer. On the switchboard are four feeders, and three bus bars. The machines can be run on to any bus bar, and if it were necessary, a machine could feed one bar at 300 volts and another bus bar at a lower pressure. This arrangement is secured by a small switch placed at the side of the bus bars, which brings in a certain amount of resistance.

The type of battery which is employed is somewhat new to English central stations, and it may be interesting to describe it.

The battery is of the Tudor type, and is made in this country by Mr. A. B. Pescatore; at present it is composed of 85 cells, but a further battery of the same number of cells is now on order, and will shortly be ready for working.

Each cell contains 21 plates, 10 positives and 11 negatives. The positive plates are of the Tudor type, Planté formed with sulphuric acid only; they have on both sides a large number of ribs and ridges, which, while securing great rigidity in every direction, give a surface equal to eight times that of a smooth plate of the same size. At the maximum rate of discharge, viz., 600 amperes, the current does not exceed 3·2 amperes per square foot of surface of + plates, and the normal capacity of 940 ampere hours only corresponds to 5 ampere hours per square foot. The plate is cast in one piece with its lugs, and ample metal is left everywhere to ensure equal working of all parts of the plates; at the same time, the active material being formed directly on the body of the plate, there is always intimate contact between the lead conductor and the peroxide. The negative plates are of the ordinary pasted grid pattern, and call for no special mention.

The working dimensions of the plates are 14 inches wide × 12 inches high; the thickness of the + plates is ½ inch, that of the negatives ⅜ inch. The weight of each + is 22 lbs., of each − 17½ lbs. The weight of plates per cell is 390 lbs, or the total weight of the cell complete with acid is 680 lbs.

The boxes are of wood, coated inside and out with acid-proof paint, and lined with lead sheet; each box rests on four glass oil insulators.

The plates are suspended above the level of the liquid by thin lugs from glass sheets ¼-inch thick, resting on the bottom of the box. Three glass tube separators, running from top to bottom between each pair of plates, are kept upright by glass strips on the top of the plates; there is a free space of half an inch between each pair of plates, and of 2½ inches below the plates.

After erection each plate is burned by means of the hydrogen blow-pipe to a common lead connecting strip, one side of which forms the + pole of one cell, the other side the − of the next. The only materials employed inside the cell are lead and glass, and the permanent connections described above are adopted in view of the fact that plates have so rarely to be taken out of the cells. Cleaning is never required, as only a small portion of the space left below the plates can be occupied, even supposing that, owing to some accident, an extraordinary quantity of active material were to be deposited. The cables for regulating, and end cells, are sweated into lead cups, burned to the connecting strips, and no screw connections are used anywhere in the battery room. The system of plates and fitting is the same as that used in all Tudor batteries.

The cells are placed on two double-tier pitch-pine stands, 35 feet long; the stands are coated with acid-proof paint, and their feet rest on large porcelain oil insulators, to ensure perfect insulation from the earth. No metal or metallic fastening is used in the construction of the stands.

Leyton.—A View of the Doulton Conduits.

The capacity at the different rates of discharge guaranteed for this battery are as follows:—

1,100	ampere-hours	for 10	hours at	110	amperes.
940	"	" 4	"	235	"
900	"	" 3	"	300	"
600	"	" 1	"	600	"

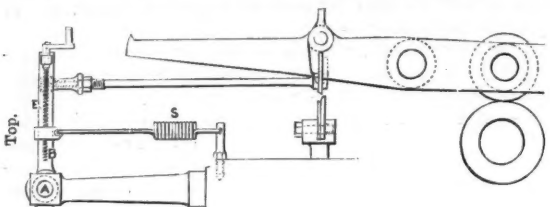
The normal rate of charge is 200 amperes, and can be increased to 400 amperes without danger to the plates.

There are about five miles of Siemens lead covered mains laid in Doulton conduits, except across the roads where the cables are laid in cast-iron pipes. The cable is of Siemens's well known type, and the conduits are such as we have described before. They are in lengths of 2 feet, and jointed on stoneware cradles with Portland cement. The distributors are three independent wires, and the feeders are concentric. The whole of the contract for underground mains was carried out by Messrs. Siemens Bros., Limited.

Street lighting by incandescent lamps has been partly

adopted, and as this is done from the ordinary lighting mains, it is necessary to send a man round to turn the lamps on. The price charged per unit is 6d., though this is subject to rebate, after the manner of the Brighton system.

Before concluding this article it will be interesting to refer to some tests on the plant which have been made by Mr. Robinson, the consulting engineer to the scheme, and by Mr. Collings Bishop, the electrical engineer to the District Council. The dynamos were run in parallel, and the current used to charge the batteries. As we have already explained when the



Note.—This block should have stood vertically.

Sketch of Variable Speed Gear on Gas Engine.

machines are used for this purpose, they are run at a reduced speed, which, of course, tells against the plant. The results of the tests, which were carried over five hours, are that 280 Board of Trade units were generated, and the fuel consumed was 448 lbs. of anthracite and 52 lbs. of coke, giving practically 1·78 lb. of fuel per unit. Taking the fuel at the full price, the cost per unit was less than ·22d., which is distinctly encouraging.

We have to thank Mr. Collings Bishop, and the various contractors, for the help they have given us in compiling this article.

ON THE MEASUREMENT OF THE INSULATION RESISTANCE OF STREET RAILWAY CABLES.*

By CHAS. HEWITT.

My attention has been called to an article by Messrs. Houston and Kennelly on "Testing Railway Feeder Cables," and published in the *Electrical World* of August 8th. It escaped my notice at the time, but after reading it I feel prompted to describe a method of testing which I instituted almost two years ago for the Electric Traction Company of Philadelphia.

I can emphasise very emphatically all the difficulties which Messrs. Houston and Kennelly have described in attempting to use any form of Thomson or D'Arsonval reflecting galvanometer, and I might add some additional troubles which I have experienced which they do not refer to.

Messrs. Houston and Kennelly refer to the induction from adjoining cables; this is a very fruitful source of trouble and error, and practically reduces all such testing to the merest guesswork. On several occasions the galvanometer showed that the current was actually coming in over the cable, as the spot of light reflected in a direction contrary to what it should. Several times I also found the battery had been injured, and was somewhat puzzled to account for it. The

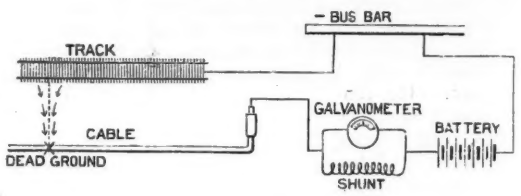
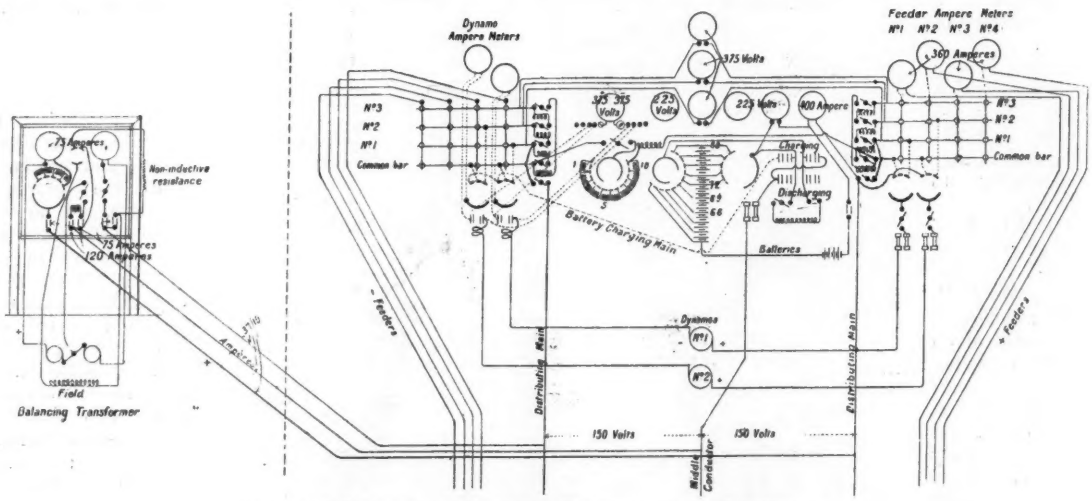


Fig. 1.

battery used was of the silver chloride type, containing 100 cells; on examination, however, the cause became apparent. The above diagram, fig. 1, shows the method of connections for making this test.

It will be noted that as soon as the battery key is closed, if the cable is already grounded, it becomes an auxiliary to the system of return cables, and I have known the current



Leyton.—Diagrammatic Sketch of Switchboard and Connections.

to actually flow back through the grounded cable and through the battery, when only a few cells were in service. After experiencing these difficulties a few times, I began to look around for something better, and although the method adopted was new to me, and so far as I was aware at the time was not in use at any other place, yet by reason of its simplicity I do not suppose it is entirely novel.

The method consists in simply replacing the D'Arsonval reflecting galvanometer by a Weston voltmeter, and using the bus bar pressure in place of the battery. The Weston voltmeter is simply a modified form of a D'Arsonval galvanometer. Since the deflection on the voltmeter scale is directly proportional to the current flowing through the voltmeter, it is evident that if we connect the voltmeter between the bus bar and the end of the cable, as shown in diagram 2, the deflection on the voltmeter scale will be a direct indication of the current flowing through the voltmeter and the insulation of the cable, from which we readily obtain the resistance of the cable. An ordinary portable Weston voltmeter with a range of 600 volts has a resistance of about 75,000 to 80,000 ohms; it is evident, therefore, that with a bus bar pressure of 550 volts this instrument will indicate the resistance of the voltmeter, which we will assume is 80,000 ohms; therefore, if when connected, as shown in the diagram, the voltmeter shows a deflection of only 1 volt or deflection, it will

* The *Electrical World*, New York.

indicate a resistance of 550 times 80,000, or 44 megohms; this, then, will be the resistance of the voltmeter and cable insulation combined; deducting the 80,000 ohms resistance in the voltmeter, we obtain the resistance of the cable insulation. As this limit of the ordinary portable Weston instrument is too low for testing ordinary cables in good condition, it was necessary to get an instrument that would have a wider range. At my request, the Weston Company made an instrument with 1 megohm resistance; with 550 volts pressure one deflection of this instrument indicates a resistance of 550 meghoms, which is amply sufficient for testing any feeder cable within my experience. The high resistance for this instrument is wound in coils external to the voltmeter proper; these coils serve a double purpose, they not only permit of the use of a more sensitive instrument than the ordinary voltmeter, but the self-induction is so large that they entirely annul all inductive influence due to the varying current strength in neighbouring cables. With such an instrument testing becomes very rapid and sufficiently accurate for all practical purposes.

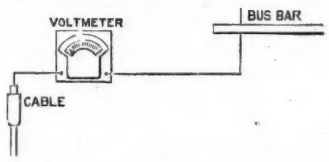


Fig. 2.

I have tried the capacity method described by Messrs. Houston and Kennelly, but the necessary calculations and the somewhat complicated method, together with the time required, make it far inferior to the method which I have described. If a fault develops in a cable we proceed as follows:

First, the cable must be disconnected from the line; it is then cut about the middle of its length, and by means of a jointed bamboo fishing pole, with a hook on the end and a wire reaching down on the inside, so as to make a complete circuit, the positive of the voltmeter is connected to the trolley wire just above the man-hole, and the negative of the voltmeter is then applied to the exposed ends of the cable in question; a momentary glance at the voltmeter

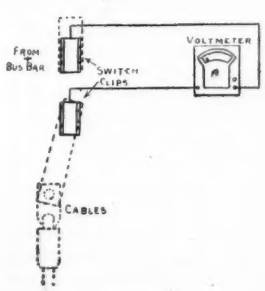


Fig. 3.

shows on which side of the cut the fault lies, the actual resistance being of no importance at this time. By being able to make this test at the point of cutting much valuable time is saved, and it is an easy matter to run down a fault in a cable several miles in length in one day; whereas, with the former method of doing all the testing from the station end, would often consume several days. This method of testing being so simple and easily applied, we at once extended it to making nightly tests of all our feeders, including the sections of line to which they were attached.

During the hours between 1 and 5 a.m. many roads are shut down entirely, while at the most in large cities, but few night cars are in operation. The switchboard man, by watching the ammeter, can readily tell whether there is a car on any section or not; as soon as he finds the section without load, he opens the feeder switch and applies the terminals of the voltmeter across the switch, as shown in diagram.

The deflection on the voltmeter indicates the resistance, not only of the cable, but all the line work on that section. There will of course in each station be a few feeders which supply lights to depôts, &c., which cannot be tested in this manner, but the majority of feeders can be so tested, and the information becomes of considerable value. One man can readily test from 35 to 40 feeders in one half hour, and in one of our stations where we have over 150 feeders, the men find no difficulty in getting over the entire board every night without interfering with their other work. A single night's record is of no particular value in itself, but by comparing the records of each night with those preceding the indications become of use. If, after several days of clear weather, any particular feeder shows signs of decreasing insulation, that feeder is thrown out of service; first the cable is tested, and if found good, the section of the line is then carefully gone over and the cause of weakness removed; in this way many burned-out cables and vexatious delays have been forestalled.

At the present time we are making nightly tests of over 300 feeders, supplying over 400 miles of trolley wire, and we do this without in any way interfering with the other work in the station or with the operation of the lines. If those railway companies who have never tried this, particularly in large cities, will use such a system, I think they will be gratified with the results. For ordinary nightly testing the ordinary portable Weston voltmeter of 70,000 to 80,000 ohms resistance is all that is necessary. For accurate cable testing I would recommend the high-resistance instrument.

MUNICIPAL WIRING AND "FREE" WIRING.

The Vestry of St. Leonard's, Shoreditch, is issuing circulars to tradespeople and residents in the parish, inviting them to make use of the Vestry's staff in wiring their premises. It is stated that as the Vestry will have to maintain a staff of wiremen and jointers for testing consumers' installations, and connecting them with the Vestry's mains, the electric lighting department will also, in order to reduce as far as possible the initial outlay to consumers, estimate for and undertake the execution of private wiring work.

The charge made for this is to be the actual cost of labour and material, plus 10 per cent. for supervision, a reasonable deposit being required before the work is put in hand. A show-room is being established at the generating station, where various styles and makes of fittings by the best manufacturers will be kept for the inspection of consumers, so that customers may be sure of having fittings which will obtain the approval of the Vestry when the installation is tested, and at the minimum cost.

There is something to be said for, and a great deal against, municipal wiring. Many companies which started with a wiring department, in addition to electricity supply, have found it desirable to drop the contracting branch, and more particularly confine themselves to the generation and distribution work. The Liverpool Company was one of the very few who continued the wiring business with success, and now that the Corporation has bought their works, and taken over the staff, this branch is retained, it being understood that no contracting work must be done outside the area of supply save with the consent of the Corporation. Ship wiring must have paid the Liverpool Company, who did a good deal in this direction, but then the organisation of the staff had grown up from the small beginnings, when the erecting of private plants was the only work to be done.

If we remember aright, the House-to-House Company at one time carried out wiring jobs, but an extended experience led the managers and engineers to advise the board to drop this branch, and now all the available skill is concentrated on the supply business. The Corporations of Stafford and Leicester engage, we understand, in wiring and putting up fittings much to the annoyance of local contractors, who, if they only knew how, might easily stop this unequal competition. According to counsel's opinion, a corporation has no legal power to enter upon such installing and fitting, as there

are no provisions covering the case in the statutes or local Acts. If we may judge from the recommendations put before the West Ham Corporation by Mr. J. J. Steinitz, who threw up the post of resident engineer at Leicester to become borough electrical engineer at West Ham, the Leicester Corporation has not, in the long run, done any good to itself, for the West Ham people are strongly advised not to attempt wiring or engage in any way in work inside the consumers' premises.

The wiring contractor is, after all, a very good friend to the supply company or electric lighting department, for, in his own interests, he vigorously canvasses the area of supply for orders, and every job he does means a steady revenue to the suppliers, while he has to look further afield as each job is finished. Wiring firms are now so numerous, and competition is so keen, that no more effective method of reaching possible consumers could be devised than to make it worth the while of half a dozen contracting firms to work a district. In the result, work is done fairly well and very cheaply, for the constant run of jobs following one upon another keeps the small wiring firm busy—if not in one place, in another—with a consequently small charge for supervision and plant and establishment charges against each job. Good work is even now being done at very low rates, and the average price throughout London is well under a pound per lamp. How ends are made to meet we really do not know; but it is evident that unless a vestry or corporation covers a very wide district, undertakes very varied classes of work, and places the management of its wiring department upon a purely business basis, it can never touch the figures for which work is being done by wiring contractors. We know of several cases where municipal engineers have estimated what it would cost to carry out some wiring work themselves, and then have asked for tenders, and almost invariably the outsider has been given the job, his price being lower than the estimated cost. And these outside firms frequently make money, for they are experts in buying, take large quantities of sundries, know the market, and are quite up to what is the most that can be done with given labour. On the other hand the municipal engineer is a central station expert, and at this cannot be beaten, but just as the wireman makes a mistake when he talks about electricity supply—a thing he has no real acquaintance with—so the station engineer cannot be so good at the other man's business as the other man himself.

It is a fallacy to imagine that a staff of wiremen and jointers, whose duty it is to test consumer's installation and connect them to the street mains, can properly estimate for and undertake the execution of private wiring work. Two or three jointers at the most ought to be able to do all the jointing on a large system; testing and connecting is usually and properly entrusted to superintendents, inspectors of mains, or house connectors—trained skilled men of some experience, who hope later on to rise to higher grade positions on the staff. Workmen are most excellent fellows when told what to do and allowed to do it, but testing and connecting are jobs that require something more than mere handicraft skill; they require a good address, as cantankerous customers are sure to be met with, faults found, and positions to be faced where something more than experience alone is necessary; there must be technical knowledge to guide the hand, and brains to dictate what shall be said and done at the proper time. We imagine that wiring will gradually fall into a separate department by itself, and be carried out by a staff deputed to do this and this only. By taking this course the work will be done better, with less friction, at a lower cost, and will interfere less with the routine of supply than if certain members of a staff are supposed to do the two different branches efficiently.

Not only is the Vestry of Shoreditch going to act as contractors, but the Free Wiring Syndicate is also to be admitted into the field. The consumer can therefore choose whether he will employ an outside contractor, make his own arrangements and pay his own price, subject to the Vestry's wiring rules being complied with, or he may go to the lighting engineer at the Town Hall, inspect the various styles and makes of fittings by the best manufacturers, pay his deposit, and have the wiring done and fittings put up at the actual cost of labour and material, with an added 10 per cent. for supervision; or lastly, by agreeing to pay for five years $\frac{3}{4}$d. per unit more than he otherwise would do, he can have his premises wired without any first charge (unless he has a mind for fancy and expensive fittings, when, we presume, he will be asked to pay for them).

The Electric Free Wiring Syndicate and the Electric Lighting Extension Syndicate have succeeded in getting a foothold in London, whereas the projected Electric Fittings Hire-Purchase Company, of a year or two ago, failed to establish a name and reputation. These companies will alter the complexion of things somewhat, and may-be tend to change the character of the load curve for many of the poorer—or shall we call them less well-to-do—residents in regions where street mains have been laid, growl heartily at the cost of altering their lighting arrangements from gas to electricity. The latter concern of the two mentioned has an additional string to its bow, in the possession of a worked out prepayment meter, or strictly speaking, an attachment to be added to any ordinary consumer's meter, and this should lead to a proportionate increase in the favour with which it is regarded.

THE "THERAPEUTIC EFFECTS OF HIGH FREQUENCY CURRENTS."*

The high frequency currents act powerfully in increasing the intensity of organic combustion, as I have before shown, writes M. D'Arsonval in *L'Electricien*. I have thought since then that this particular mode of action of the electrical energy might be beneficial in that class of maladies so deeply studied by my learned *confrère* and friend, Professor Bouchard, under the name of "diseases attributable to imperfect nutrition." Certain forms of sugar diabetes, gout, rheumatism, obesity, &c., are included in this category.

I have therefore instituted, since the beginning of this year, a series of clinical researches relating to this subject. The experiments took place at the Hôtel Dieu, in the wards attended by my assistant, Dr. Charrin, and under his supervision from a medical point of view. The results obtained up to the present so completely fulfilled my expectations, that I think it will be interesting to quote some of them. I will now show in what spirit these researches were instituted, and what was the plan followed. I utterly reject all results into which the appreciation of the patient enters, taking note exclusively of physical—chemical or clinical modifications that can be accurately and objectively measured. I thus completely eliminate subjective improvements that might be attributed to suggestion. This cause, which is invoked too lightly by certain doctors to explain certain cures undeniably due to electricity, has no part in the facts that I am about to quote. Moreover, the positive results previously obtained from animals, and which we find repeated in our patients, quash this objection, *a priori*.

The following observations relate to two diabetic subjects, and one patient suffering from obesity.

The variations of temperature were noted twice a day, and also the arterial pressure, which was measured by means of our colleague, Professor Potain's sphygmometer. The analysis of the urine was performed by M. Guillemonat, house-surgeon, who proceeded as follows: every day a certain proportion, say $\frac{1}{5}$th of the total volume, was taken from the urine discharged during the 24 hours. Every five days it was analysed. By this mode of procedure, we get a mean which eliminates the causes of error due to the daily variations in the diuresis. Of course precautions are taken to prevent decomposition. The uro-toxic co-efficient of the urine, the importance of which is now fully recognised, thanks to M. Bouchard's researches, was taken by M. Charrin in his own laboratory. Lastly, the current was applied with great care, under my directions, by M. Bonniot, visiting surgeon, who had attended my lectures and who was a pupil of Drs. Tripier and Apostoli. Every precaution was taken, in short to render these observations accurate and so to ensure their value.

The analysis of the gases of the breath and also the calorimetric radiation of the patients will also be taken shortly. A word now with regard to the instrumental arrangements for producing the high frequency currents at the patient's bed. I could not use the very convenient apparatus described in my former note, as the Hôtel Dieu is not connected with the

* Note presented to the Académie des Sciences, July 6th, 1896.

electrical sector. To charge the condenser periodically, I was compelled to have recourse to the Ruhmkorff coil, actuated by accumulators. The well-known trembler of this apparatus has one great drawback.

Under the influence of the powerful current passing through it, the hammer is soon held tight to the anvil, and this short circuiting soon brings about the deterioration of the bobbin and the accumulators, if this result is not guarded against by strict supervision. In order to avoid it, I directed M. Gaiffe to introduce the modification shown in fig. 1.

The anvil, instead of being fixed, turns with a continuous rotatory movement, kept up by a little electromotor actuated by a derivation of the current conveyed from the accumulators. If adhesion does occur, it cannot continue, and thus the interrupter can work without supervision. The coil charges the plane condensers connected in the cascade style, and contained in the flat box by the side of the coil; the high frequency current is taken as usual at the extremities of the solenoid. Its intensity is regulated by taking a larger or smaller number of spirals, and it is measured by introducing into the circuit the galvanometer shown in fig. 2, which is constructed for measuring high frequency currents. It is a thermic galvanometer consisting of a fine wire, the heating of which is shown by variations in its length, which are indicated by a needle moving over a dial which is divided experimentally into milliamperes on one side and volts on the other.

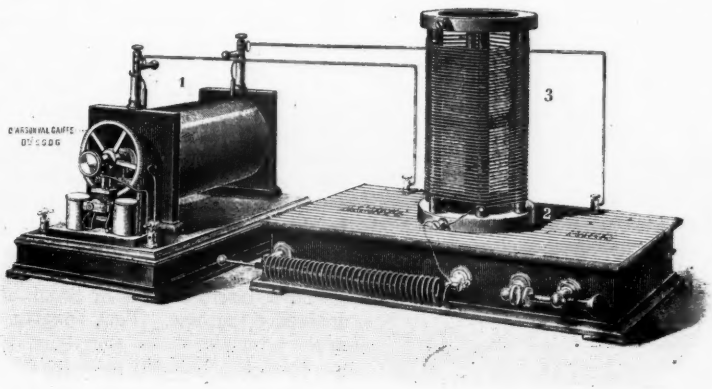


Fig. 1.

This apparatus enables currents, the intensity of which exceeds 500 milliamperes, to pass through the body.

I have already described three of the principal modes of procedure for electrifying by means of high frequency currents: the first consists in conveying to the part of the body to be electrified the current emanating from the solenoid by conductors provided with suitable electrodes; the

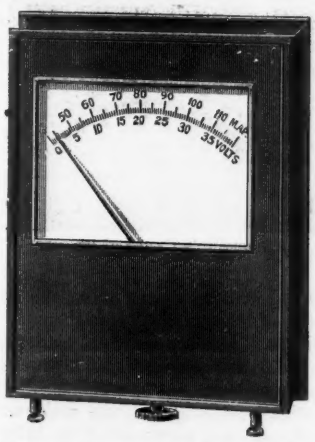


Fig. 2.—Universal Galvanometer.

second consists in placing the patient in a solenoid, not touching him, but inducing in his body currents of the same frequency: this is the auto-conduction or induced faradisation method; in the third, the patient constitutes one of the armatures of a condenser charged statically by the solenoid, as shown in fig. 3.

In the following cases, the first method was employed. The current proceeding from the solenoid passes through the whole body from the feet to the hands. One of the poles of the solenoid is in communication with the water of the foot-bath in which the patient immerses both feet; the second pole is connected with both hands by a bifurcated conductor ending in metallic handles. Under these conditions the current was generalised and its intensity varied from 350 to 450 milliamperes; the duration of the treatment, which was undergone daily, and which lasted at first 10 minutes, was afterwards reduced successively to five and three minutes, according to the impressionability of patients. This current, I repeat, exercises no perceptible action either upon the sensibility or the motive powers, so that patients do not object to submit themselves to the treatment. I will now rapidly sum up the observations made.

Case I.—A man of 33 years of age, a mason, suffering from acute diabetes of four years' standing, was put under observation for a fortnight without being subjected to any treatment.

Under these conditions, he passed, on an average, 11·3 litres of urine in 24 hours, containing 54 grammes of sugar per litre or 620 grammes of sugar a day. The arterial pressure was only 15 cm. of mercury; the pulse was 72, and the temperature below the normal. The poisonous element in the urine was almost nil: 250 grammes injected into a rabbit scarcely made it ill.

The high frequency current was applied for a period of 10 minutes daily. The first few days we noted the disappearance of pains in the limbs; the sleep improved and not interrupted by thirst or the desire to pass water, and not disturbed by nightmare; greater clearness of vision, the return of memory and clearness of thought rendering reading possible. So much for the subjective phenomena: the objective results were as follows: the disappearance of a malleolar swelling reaching half-way up the leg, the diminution of a certain amount of dropsy and the return of feeling to the legs, which had previously been devoid of feeling.

For the first week there was little change with regard to the urine and the production of sugar, with the exception that the diuresis became more regular and no longer presented sudden variations, passing from 7 to 13 litres in the 24 hours.

In the second week this was rapidly modified, and after the treatment had been continued for 42 days the following facts were recorded: the mean quanity of urine for 24 hours, 7 litres; sugar discharged in 24 hours, 180 gr.; arterial pressure 25 cm. on the 20th day, pulse 104, temperature rising to 38°, and finally stopping at 37°. The poisonous element in the urine considerably increased. After one month it killed in the proportion of 64 gr. to 1 kilogramme. Lastly, as to variations in weight, this fell at first from 57·5 kg. to 51 kg., and then gradually rose to 56 kg.

Case II.—A woman of 59 years of age, diabetic subject, corpulent, presence of sugar noted two months ago for the first time, treated on several occasions for albuminuria. At present no albumen and no nephritis. Quantity of urine passed in 24 hours 3·3 litres, containing 43 gr. of sugar per litre, or 137 gr. per day. Craving for food and drink, general weakness, curvature and pains in the limbs. Arterial pressure very high, from 27 to 30 cm. of mercury, pulse slow, 64 beats per minute, temperature slightly above the normal, varying from 37·3° to 37·5°. Poisonous element in the urine 107 gr. per kilogramme.

Electrical treatment was carried out for periods of 10 minutes and was well borne, but left a feeling of great lassitude afterwards. After 15 days of treatment there was no variation in the quantity of urine passed in 24 hours, but

the sugar had been reduced to nearly half the quantity, 24 gr. per litre instead of 43 gr. The arterial pressure fell to 25 cm. of mercury, the pulse rose to 76 or 80, the temperature was not much affected. The poisonous element in the urine amounted to 87 per kilogramme. Notwithstanding the diminution in the sugar, the improvement felt was not so great as in the preceding case. The treatment was suspended for a few days and then resumed for periods decreasing successively from 10 minutes to 3 minutes. The patient felt rested, slept well, had no more curvature, and the quantity of sugar eliminated fell to 38 gr. in 24 hours. This case shows the importance of technical knowledge in this kind of treatment. What should be the number and the duration of the sittings? Should they be undergone less frequently, or suspended for a time? There are many other questions that experience alone can decide.

Case III.—This was a coachman, aged 36 years, suffering from obesity, weighing 130 kg., and showing a marked irregularity of the heart's action. The treatment was carried out for 10 minutes daily. He was better for some days. The quantity of urea excreted rose from 33·72 gr. to 41·63 gr. in 24 hours. The pressure rose from 18 to 20 cm. of mercury, and the pulse from 72 to 108. At the end of 15 days the patient confessed to having had attacks of dyspnœa which he had concealed, having great confidence in the treatment and not wishing it to be suspended, the amount of urea decreased, falling to 24 gr. per day.

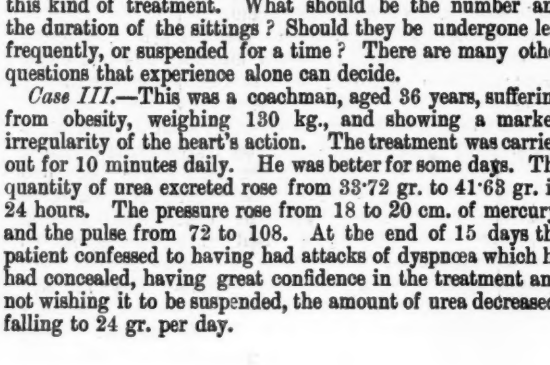


Fig. 3.

The treatment was discontinued for a fortnight and was then resumed with shorter periods, three minutes instead of 10. After a few days there were the same symptoms of dyspnœa, diminution in the amount of urea and in the arterial pressure. The treatment was discontinued. The poisonous element in the urine varied little, being 84 at the commencement and 87 after the last experiment. This observation shows that the high frequency current acts, as always, powerfully upon the circulation, that there are counter-indications, and that suggestion is not sufficient to explain the beneficial effect of electricity, since this patient, who did not benefit by the treatment had faith in it, unlike the preceding cases who were quite surprised to find themselves better.

If this new departure in therapeutics is full of promise, I must warn doctors that much remains to be done from a clinical point of view. I have shown experimentally that the high frequency current acts powerfully upon the system; there ends, for the present, my rôle of physiologist.

I will add a few words as to the theoretical point of view. Why is it that these currents, the action of which is so powerful, do not act upon the sensibility? Physicists say that it is because of their superficial localisation. I have shown by many proofs of a physiological order that these currents, on the contrary, penetrate deeply into the system and act considerably on the vaso-motor centres. Physicists have not reflected that their explanation only applies to bodies that are good conductors, like metals. In the case where the conductor under considerations has only the conductivity of the human body (which is less than that of water containing 1 per cent. of salt), these same formulæ show that the distribution of the current throughout the system should be to all intents uniform. This can, moreover, be easily verified as I have verified it with a glass cylinder full of salted water, the length of the cylinder being 70 cm. and its diameter 25 cm. The density of the current taken along the axis or near the glass did not vary by $\frac{1}{100}$th of its value.

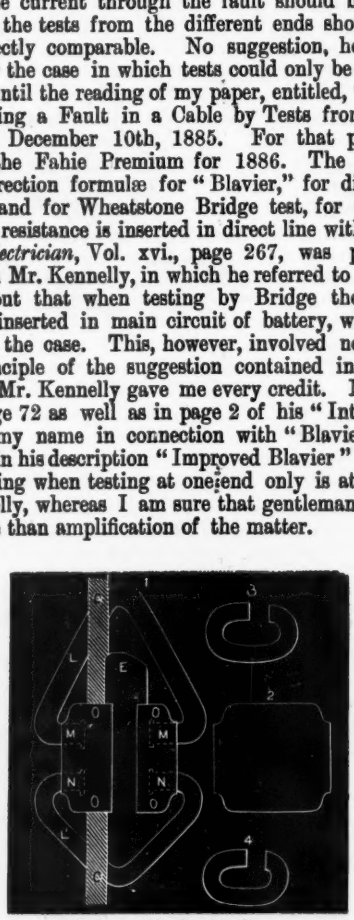
The true explanation of the harmlessness of these high frequency currents is therefore quite of a physiological nature, as I have said from the beginning.

CORRESPONDENCE.

Submarine Cable Laying.

I should be pleased if you would publish in the columns of your paper the following remarks on statements liable to mislead, which are contained in Mr. Wilkinson's valuable work on "Submarine Cable Laying and Repairing."

Messrs. Anderson and Kennelly were, as far as I know, the first to publish a method obviating the error which almost invariably accompanies the application of "Blavier." They suggested tests from each end, and the insertion of resistance, so that the current through the fault should be made the same, and the tests from the different ends should be thus made directly comparable. No suggestion, however, was offered for the case in which tests could only be taken from one end, until the reading of my paper, entitled, "A Method of Localising a Fault in a Cable by Tests from One End only," on December 10th, 1885. For that paper I was awarded the Fahie Premium for 1886. The paper contained correction formulæ for "Blavier," for direct deflection test, and for Wheatstone Bridge test, for the case in which the resistance is inserted in direct line with the cable. In the *Electrician*, Vol. xvi., page 267, was published a letter from Mr. Kennelly, in which he referred to my method, pointing out that when testing by Bridge the resistance should be inserted in main circuit of battery, which is undoubtedly the case. This, however, involved no alteration in the principle of the suggestion contained in my paper, for which Mr. Kennelly gave me every credit. Mr. Wilkinson, in page 72 as well as in page 2 of his "Introduction," mentions my name in connection with "Blavier modification," but in his description "Improved Blavier" the method for correcting when testing at one end only is attributed to Mr. Kennelly, whereas I am sure that gentleman would not claim more than amplification of the matter.



Kingsford's Cable Grip.

On pages 390 and 391 are a description and sketch of "A Mechanical Form of Stopper," "introduced" by Messrs. Johnson & Phillips. I believe myself to be the original inventor of the wedge stopper, for which a provisional patent was taken out June 19th, 1895, number 11,929, Messrs. Johnson & Phillips becoming the sole makers.

It may seem to some not worth while to take any notice of so simple a matter as I here deal with, but I would do so on principle, however insignificant the invention might be. Simple as the device is, many years elapsed before the "wedge in a holder" plan of stoppering a cable was thought of, although the need of a mechanical stopper had long been felt. In my own experience alone this wedge grip has proved a considerable saving of time and money. We use a form shown in the accompanying drawing, in which the entire circumference of the cable, as well as part of the wedge, is contained in the same recess in the wedge holder.

I may mention that the grip is useful, not only for securing the cable over the bows; but in other cases, notably when a cable suddenly becomes mechanically weakened in paying out. For such casualty we keep handy a "grip," attached to 100 fathoms or more of manilla rope, so that in the event of damage occurring on board, the grip would instantly be placed on the cable near the paying out sheave, and the rope would, of course, run out, the engines being put full speed astern.

H. Kingsford.

Lima, Peru.

P.S.—Some time after the reading of my Blavier paper referred to, you were kind enough to publish for me a *résumé* of the matter, together with the description of a key designed for False zero testing.

KINGSFORD'S CLUTCH LINK ROPE OR CABLE GRIP.

In the accompanying sketch, fig. 1 shows the clutch in elevation, in which 00 is the clutch link. Fig. 2 is a view of the back of the clutch link. Fig. 3 is a horizontal section through the upper portion of such clutch link. Fig. 4 a like section through the lower portion; L, L', are links, movable at the points, M and N, link L being for one end of a chain, the other end of which is made fast on the ship, and link L' being for a chain attached to a second clutch link should it be desired to use two, or to enable ordinary stoppering, should such be desired. C is the cable or rope. The clutch link has a hollow rounded core, rather wider at the top than the bottom, with an opening in front wide enough to allow the passage of the rope. E is a semi-circular gouge-shaped wedge, fitting into one side of the hollow in the clutch link. The wedge is slid up or removed, so as to allow the entry of the cable,; the cable having entered, the clutch link is jammed by the wedge, a blow being given to the head of the wedge to make all tight.

A Scheme for Lighting Jersey.

We cannot refrain from sending you this cutting, taken from the *Jersey Weekly Press and Independent*, Saturday, November 7th, 1896, as it seems a new departure, and a bold one, from the usual lines adopted by electrical engineers:—

MR. ROUSSEAU'S ELECTRIC LIGHTING PROJECT.

We hear that the States' engineer and Mr. A. J. Rousseau, our Jersey electrician, were at work at the Breakwater (Elizabeth Castle), on Monday, at La Collette, and at the old French Quay (near the Lifeboat Station), fixing the sites where Mr. Rousseau is to erect his hydraulic machines, to produce the motive power to work his dynamos for lighting the harbours, and also the town of St. Helier, by electricity. It appears that Mr. Rousseau feels so sure of the final result of the electric lighting of the town being carried out by him, that he will at once prepare the foundation of these three sites to enable him to light up the town by electricity at a very short notice.

Mr. Rousseau claims, we believe, to have invented a hydraulic machine which, although he places by the sea, is in no way dependent upon the tide.

Perhaps you can throw some light on this scheme, which, to us, appears an impossibility?

Sceptic.

An Exhibition of Commercial Electricity.

The light day load of a central electric lighting station is undoubtedly a cause of anxiety to many engineers, and, though numerous efforts have been made to increase the day demand by means of reduced charges and sliding scales, these do not appear to have materially improved the situation, and it is important to ascertain if any adverse circumstance can be discussed and overcome.

The fault is not in the price per unit, or even, with the majority of cases, in the system of supply, and it would be unjust to our manufacturers to hint that their motors are inefficient; but it is, I consider, to be found in the extreme ignorance shown by the directors, managers, and foremen of many factories and works of the advantages, or even existence, of electric motors.

This ignorance is injurious alike to the supply company, the motor manufacturer, the wiring contractor, and the factories concerned, and it is desirable that every effort should be made to counteract it.

Now to send a catalogue or a canvasser to the factories is not sufficient; one is soon found in the waste-paper basket, and the other in the street, the useful result being nil. It is necessary to bring a series of practical object lessons, on a commercial scale, before those concerned, and to show them that their machinery can be driven as well, as cheaply, and more conveniently and safely by electric power than by any other.

This could be accomplished by holding an exhibition of commercial electricity, in which continuous, alternating, polyphase, &c., motors should be shown in motion coupled direct to typical machines, or driving shafting; while, to further attract the public, there should also be a display of electric lighting, cooking, welding, &c., together with signals and telephones, as well as electrolysis and the applications of electricity in general.

A number of suitable positions could be found in London; one large hall in the Northern district has an efficient private and public continuous and alternating supply available, and it would not be difficult to obtain the services of an independent expert committee to make all necessary arrangements.

An exhibition cannot, however, be held without money; but I venture to think that, with the assistance of the Institution of Electrical Engineers, the supply and manufacturing companies, together with the receipts at the doors, the required amount could be raised, and a permanent increase of business secured.

Chas. A. Gawthorp.

Electricity in Mines.

Mr. Steavenson's reply to Mr. Appleby seems not to have been sufficient, and Mr. Appleby now lugs in more fallacious arguments. The reference to D. K. Clark is valueless to prove that compressed air cannot give 70 per cent. efficiency. Clark refers to old-fashioned plants, with no modern improvements; and so also does Mr. C. A. Hague, also cited by Mr. Appleby. Mr. Hague expressly states that the plant he tested was old-fashioned, and with no pretence to modern ideas, water-power being plentiful, and cheap efficiency was of no importance.

In the same line of argument used by Mr. Appleby, it would not be difficult to find some old transmission of power by electricity plants which do not give even 35 per cent. efficiency, and it would be quite as fair to use them against electricity.

Like Mr. Steavenson, I prefer Prof. Unwin and Prof. Kennedy as authorities on compressed air, with all due respect to Mr. D. K. Clark and C. A. Hague.

As to whether ordinary or commutatorless motors will be exclusively used in fiery mines, I am content to leave the answer to the test of time.

Reheating of compressed air can be applied in any mine where a motor with a commutator would be allowed. My position is this: we cannot claim superiority for electricity on the efficiency question, but in first cost, convenience, and maintenance, electricity is by far cheaper and better, and in the fiery mine only induction motors are allowable.

Rankin Kennedy.

The "Universal" Engine.

The discussion on my paper on "Cheap Steam Power" before the Northern Society of Electrical Engineers, brought out one fact very clearly which I had not previously appreciated, viz.:—That the valves of the Universal engine are not generally understood. Both Mr. Maclaren and Mr. Ferranti spoke under the impression that the valves were of the cylindrical pattern, depending for steam tightness on their fitting accurately the valve casing.

I freely admit that the published drawings distinctly favour this view, and I find no fault with my critics for expressing it.

The actual facts are as follows:—

The high pressure valve seating is lapped out accurately to gauge; the valve is then carefully fitted so that it may be quite steam tight when the engine leaves the works. The valve is then put in a lathe eccentrically, and rather more than half of its circumference reduced, so that it may bear solely on the surface adjacent to the ports. The valve is as free as any Corliss valve to follow up as it wears.

The cylindrical form is chosen partly for strength and partly in order that steam may enter freely from one end of the valve box. The low pressure valve is arranged with a

preponderance of pressure towards the lower ports, so that it may always wear in that direction.

The tendency, of course, is to render the upper or H.P. port leaky, but that is of no moment, for the upper part of the valve may be cut away without permitting steam to pass. I retain the upper part, however, for two reasons:—

Firstly, to facilitate manufacture.

Secondly, to interpose a door between the live steam and any water which may be left lodging in the valve from the preceding stroke.

Should any serious wear show itself in this valve, it will then become simple Corliss, neither better nor worse.

The Universal engine as made by the Brush Company, is a combination of many parts, some being novel, and some merely developments of existing ideas. The arrangement of cylinders and valves is, however, applicable to any engine, and the object of my paper was principally to show that the theoretical and practical knowledge which we possess of the action of steam within the cylinder leads to the belief that the adoption of this construction in combination with any existing pattern of steam engine would reduce both prime cost and working expenses.

The test figures of steam consumption were adduced merely as collateral evidence in support of this view; they were not actually necessary, because the theory of the steam engine is now sufficiently firmly established to enable the performance of an engine to be approximately estimated from the drawings.

John S. Raworth.

AMERICAN STREET RAILWAY MEN IN CONFERENCE.

Few things could possibly better illustrate the difference between "street railway" (*i.e.*, tramway) enterprises in the United States and in this country, than the reports of meetings held by the respective tramway associations. Here, the Tramways Institute hears papers upon, and desultory discussions concerning, car starters of the coiled spring variety, new ideas in horse-shoes, or the best kind of winter food—varied by occasional references to gas motors or complicated conduit systems: over in the States they discuss matters dealing entirely with mechanical systems—and a typical bill of fare is that just gone through by the American Street Railway Association at their annual meeting, held this year at St. Louis. The subjects dealt with include such questions as "Tracks and Track Joints: Construction, Maintenance and Bonding;" "Trucks;" "How to Increase Revenue by Transfers, &c.;" "Modern Overhead Construction;" "The Modern Power House;" "Selection and Management of Employés," &c., all of these being topics of a live and interesting nature.

Progress in traction methods over there is shown for one thing by the fact of the Association meeting in St. Louis, despite the cyclones of the past summer that worked such havoc in the city, and not least among the splendid street railway systems that St. Louis has, with justice, been proud of. More than one power house and depôt was crushed flat a few months ago, but it takes less time to re-equip a line in the States than it does here to have plans passed by a local authority, and street railway men at the conference would probably find little trace left of the damage done. In welcoming the visitors and attending members, the Mayor of St. Louis commented with amused satisfaction upon the developments of the past decade, and some of his words are worth quoting:—"In looking over some of your old reports, I find that within 12 years you have been considering such subjects as 'salt' and 'glanders.' Now, I must say that when I read that I felt compelled to rub my eyes to remember what salt and glanders could ever have had to do with a street railroad system. It read to me like ancient history, and you will not be surprised, for to an untrained mind other subjects such as electric apparatus, fenders, head lights, &c., suggested themselves rather in this connection." We *hope* that no more than 12 years will elapse before tramway men in this country will have reached the same point of development in mechanical traction at which they stand to-day in the States; and we say this mainly with reference to quantity rather than quality.

The president's address at the St. Louis Convention dealt largely with legal questions, such as increased taxation coupled with limitation of fares (it must be remembered that the tramways in America are almost entirely, if not indeed wholly, owned by companies, and not by municipalities or local authorities, as we find here to be increasingly the case), and law suits for damages on account of personal injuries—many of these, perhaps the majority, being more or less fraudulent; the president did not, however, omit to notice (without great anxiety) the rapid extension of bicycle riding and the possible consequences to the use of tramcars. The first paper read, by Mr. M. K. Bowen, discussed the ever burning question of track, and the paper—itself of no little practical value—called forth still more practical expressions from the members present. Mr. Bowen recommended first that rail sections should be chosen to conform with those of the car wheel from the outset instead of allowing mutual wear to adjust the surfaces. As to the composition of rail steel, it seems that the harder it is and becomes through rolling, the longer it wears. Rail joints, he said, should be made solid and rigid, as, for instance, by cast welded joints; but these are not to be relied upon for the electrical connections, and must be bonded in the usual way. In converting old horse lines into electric systems, or rebuilding lines for heavier traffic, he had found by test that the cost of re-equipping the permanent way was practically paid for in less than two years by the saving in power required; dynamometer readings gave results which showed a pull on the old road 13·75 lbs. per ton more than on the new track. The discussion upon this paper brought out some interesting facts: one member mentioned a line 13 miles long, mostly in 60-foot rails, all welded together and without a single bond. Careful tests of a single joint and mile lengths had shown no necessity for bonding. As, however, these joints were not a year old, they had not experienced the full change of seasons; Mr. Bowen had stated in his paper that the difference in temperature between winter and summer broke 154 joints out of 17,000 on his lines in Chicago. The metal used for these cast welded joints is composed of 25 per cent. scrap iron, 25 per cent. soft, and 50 per cent. hard silicon pig, and about 100 lbs. is used per joint. In repairing a broken joint or rail a short piece of rail (say 3 inches) is cut in and cast around at both joints. Various members gave testimony as to their experience with cast joints, some favourable, others less so; but the general conclusion seemed to be that much progress had been made in the methods followed, and on the experience acquired there was fair promise of over-coming all the difficulties that had developed. At present—as one speaker remarked—it is better to bond and be sure, than not to bond and be sorry.

The papers dealing with overhead construction and power house design we hope to notice subsequently; space forbids more now beyond a brief reference to the discussion following upon the paper entitled "Selection and Management of Employés." Evidently the "handle-twisters" or motor men in the States are men of a good class and earn good money if they are to be provided with (as seems a common thing) reading rooms, lavatories, and gymnasia—not to speak of a small theatre, with a piano and a dancing master, to give lessons to wives and daughters—as well as themselves! The main point touched upon, however, was that of preventing carelessness in driving, &c., either by fines or dismissal, &c. Further proceedings took place *in camera*, and were not reported, presumably from respect of the employés' trade union, which might have inconvenient remarks or acts to follow. It is, however, worthy of emphasis that the adoption of mechanical systems in tramway working should have tended so strongly to advance the position and status of the men employed.

LEGAL.

Edison Bell Phonograph Corporation, Limited, *v.* Bernstein.

In the Chancery Division of the High Court of Justice on Thursday, the 12th inst, before Mr. Justice North, in this case Mr. J. C. Graham said he was instructed on behalf of the plaintiffs to move for an interim injunction to restrain the infringement of two of their patents granted in 1886 and 1889. The latter patent had been certified after trial, but they had never been able to get a defendant to try the patent of 1886. He understood the defendant wanted time to answer affidavits, and he had no objection to time being given.

Mr. Willis Bond for the defendant asked for the time referred to, adding that the plaintiffs had known of the defendant selling the things complained of for two years.

Mr. Graham dissented.

Mr. Justice North directed the motion to stand over for a fortnight, affidavits to be delivered on Friday, the 20th inst.

BUSINESS NOTICES, &c.

A Good Dividend.—The Allgemeine Electricitäts Gesellschaft, of Berlin, is declaring a dividend of 13 per cent. for the financial year 1895-96, as compared with 11 per cent. in 1894-95.

Announcement.—We are asked by Messrs. Russell and Russell, of 49, Queen Victoria Street, to state that all debts owing by the late firm of Russell & Lennard are payable by Mr. R. F. Barrett Lennard, of 135, Victoria Street, S.W.

Changes of Address.—Messrs. Thorpe and Salter give notice that after the 30th of November, their works and offices will be removed to more commodious premises at 17, Red Lion Street, London, E.C.

The Carbon Syndicate, Limited, has removed from 3, Whitehall Place, to 39, Victoria Street, S.W.

Electricity in Steel Works.—The Albion Steel Works at Briton Ferry, South Wales, have entered into a contract with Lewis and Fletcher for electric lighting and motive power plant.

Electricity in Mining.—Messrs. Ganz & Co., of Buda Pesth, have secured a contract for the supply and installation of a plant at the Wikyowitz coal mines at Petrykowitz, in Prussian Silesia, for electric lighting and power transmission purposes.

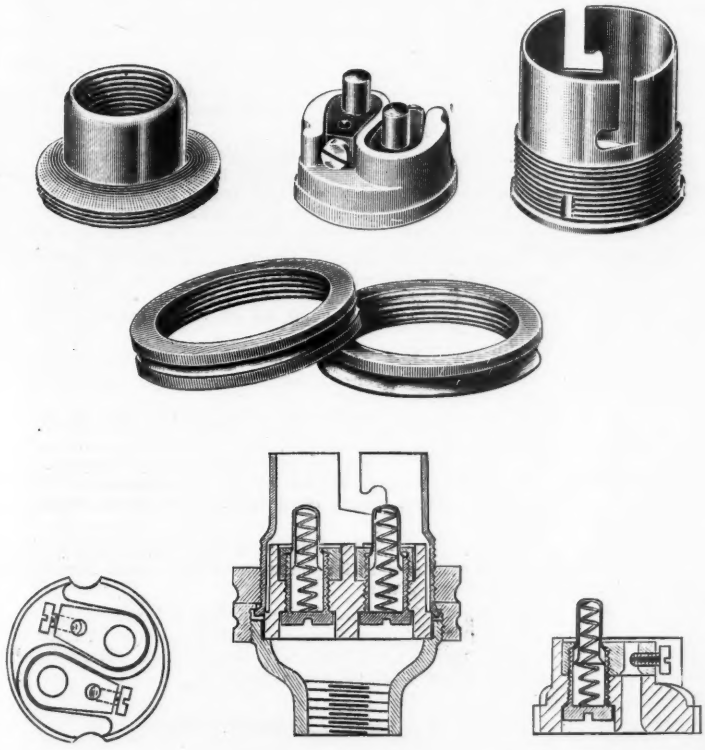
Embezzlement.—Mr. Newton, at Marlborough Street police-court, has sentenced a salesman formerly employed by Mr. H. D. Barclay, electrical engineer, of Oxford Street, to three months imprisonment for embezzling £144 belonging to his employer. He had hitherto borne an irreproachable character.

Electrical Wares Exported.

Week Ending Nov. 17th, 1895.	£	s.
Adelaide	525	0
Aden	30	0
Alexandria	109	0
Algoa Bay	10	0
Amsterdam	98	0
Bermuda	10	0
Bilbao	650	0
Bombay	54	0
Brisbane	30	0
Buenos Ayres	161	0
Cape Town	127	0
Coolgardie, Elec. cable	142	0
Colombo...	57	0
Delagoa Bay	2,688	0
East London	115	0
Ghent	50	0
Gothenburg, Teleg. wire	70	0
Madras, Teleg. mtl. ...	480	0
Malta	7	0
Melbourne	61	0
Passages...	1,840	0
Rotterdam	167	0
Santos, Teleg. mtl. ...	365	0
Shanghai	5	0
Spezia	408	0
Stockholm	50	0
" Teleg. mtl....	140	0
Sydney	90	0
Trinidad	52	0
Total	£8,591	0

Week Ending Nov. 17th, 1896.	£	s.
Amsterdam	40	0
Antwerp	46	0
Auckland	450	0
Bombay	100	0
" Teleg. wire ...	27	0
Buenos Ayres	895	0
" Teleg. mtl.	132	0
Calcutta	275	0
Cape Town	300	0
Christiania, Teleg. wire	50	0
Colombo	50	0
Copenhagen, Teleg. mtl.	80	0
Durban	311	0
Dusseldorf, Teleg. mtl.	129	0
Flushing	7	0
Gothenburg	23	0
Hamburg	179	0
Launceston	150	0
Lisbon, Teleg. mtl. ...	53	0
Melbourne	102	0
Ostend	10	0
Passages...	770	0
Rosario, Teleg. mtl. ...	205	0
Santos, Teleg. mtl. ...	628	0
Singapore	17	0
Stockholm	14	0
" Teleg. mtl. ...	361	0
Suez, Teleg. mtl. ...	78	0
Sydney	1,727	0
Townsville	150	0
Vancouver, B. C. ...	22	0
Yokohama	250	0
Total	£7,571	0

High Insulation Lamp-Holders.—The accompanying figures show the construction of a new type of lamp-holder made by the Edison & Swan United Electric Light Co. specially for use on high tension circuits. From the peculiarity of its design, it is named the "S" holder. It will be noticed that the interior, which is a block of porcelain, has two deep indentations formed by a ridge in the shape of the letter S, into which are sunk metal blocks fitted with contact plungers. This arrangement effects the complete separation of the poles, and prevents contact with the outer metal case.



Gas.—A gas explosion at Daybrook, near Nottingham, on 14th inst., badly burnt several persons and damaged the premises.

A gas explosion, on 13th inst., wrecked the Gainsborough Constitutional Club.

An explosion at Park Street, Cambridge, on 13th inst., injured a lady occupant and wrecked the premises.

Lamp Reflector.—The illustration shows a new incandescent lamp reflector which Messrs. Krupka & Jacoby are introducing. The shade, which is made of tinned metal, is soldered on to the holder of the lamp, so that whenever it becomes necessary to put a new lamp in, the holder can be soldered on afresh.

Fire.—A portion of the premises of the United Asbestos Company at Millwall were destroyed by fire on Monday night.

We are asked to state that only a small branch of the company's manufacturing business was destroyed, and arrangements have been made for the business to be carried on at the main works at Harefield Mills during reconstruction.

The Star Reflector.—The "Star" Reflector for incandescent lamps is mounted in brass with ordinary bayonet contact for attachment to a Swan holder, and has at its other end a screw fitting, into which to fit the incandescent lamp (central contact) with a miniature Edison screw contact. The silver sediment constituting the mirror is protected on both sides, so that the glass preserves the mirror fully against any damage from dampness or rough handling. The "Star" Reflector weighs only about 2oz. The sole agents are the Electrical Manufacturers, Limited, of Upper Thames Street.

Price Lists.—Messrs. H. Binko & Co., of London, have issued an illustrated price list of induction spark coils for Röntgen radiography, also bichromate batteries.

Mr. Thomas Henderson, of Liverpool, is introducing his patent improved mechanical stoker and self-cleaning furnace, lists of which are before us.

Snyers's patent elastic clutch or coupling is illustrated and particularised in a well-printed list, issued by the sole licensees and makers, Messrs. Cowlishaw, Walker and Co., Limited, of Etruria, Stoke-on-Trent.

London Health Electrical Institute, Limited.—The petition of R. O. Hearson for an order to wind up this Company was again before Mr. Justice Vaughan Williams, on Wednesday, in the High Courts of Justice, when a further adjournment was made for a week in order that additional evidence might be produced for the information of the Court as to the position of the Company at the time of the issue of the debentures, and at the first balance taken subsequent to that issue.

Motor Car Charging Station.—The dynamo for the first charging station put down in this country for electric motor cars which has been opened at the White Hart Hotel, Reigate, was supplied by Messrs. John Turner & Sons. We understand that at Reigate Mr. W. R. Wakley, the chief engineer of Messrs. Maple & Co., has erected quite a model station.

Partnership.—We are informed that the partnership hitherto existing between Mr. H. Thorpe and Mr. Harold Waring has been dissolved, and in future Mr. H. Thorpe will carry on business in conjunction with Harry J. Salter, Electrical Engineer, of 12, Cazenove Road, N., under the title of Thorpe and Salter, at 34, Eagle Street, W.C., and 12, Cazenove Road, N.

Swansea Triple Scheme.—A special statutory meeting of the Borough Council has resolved to promote a Bill in Parliament for the purchase of the tramways and the erection of electric lighting and dust destructor works.

ELECTRIC LIGHTING NOTES.

Austria.—A central station has been opened at Cracow.

Ayr.—Mr. E. G. Pink, the electrical engineer, reports that the whole plant worked well during the month of October. The mains were now all right, and he did not anticipate any further failures. In consequence of the heavy load on the north side of High Street there was a heavy fall of pressure at the Old Bridge. It would be necessary to run a short piece of cable across the street from the Colosseum corner to ease that load. The estimated expenditure and receipts for the past month were as follows, the all round revenue from meters being taken at 6d. per unit to allow for the discounts given. The expenditure given was within 5 per cent. Total works' costs for October, £94 13s. 2d.; receipts (estimated), public lighting, £42 13s. 4d.; private lighting, 8,850 units, at 6d. per unit, £221 5s. —total £263 18s. 4d.; balance to interest and sinking fund, £165 5s. 2d.

Barking.—The Urban Council are going to apply for a provisional order.

Battersea.—The Vestry has resolved to ask the County Council for a loan of £5,000 for lighting the municipal buildings.

Bowness.—A deputation of shippers and traders has urged the Harbour Board to introduce the electric light at the Bowness Docks.

Cheltenham.—Alderman Norman, at the last Council meeting, stated that for the week ending October 24th the output was 2,775 units; for October 31st, 2,919 units; November 7th, 3,119 units.

A Local Government Board inquiry was held on Tuesday into the Corporation's application for power to borrow £2,620 for electric lighting purposes.

Coventry.—The electric light is making satisfactory progress. There are about 5,245 lights now connected, and application has been made for 300 more lights.

Derby.—In future the meter-rent charge will be remitted to consumers whose annual consumption of current is equivalent to 20s.

Dublin.—In view of the increasing number of private installations in Dublin, the *Dublin Evening Telegraph* thinks that the Corporation will need to expedite its arrangements to meet the demands of new customers.

Fleetwood.—Sir Courtenay Boyle has requested an interview with representatives of the Council, *re* the proposed transfer of the electric lighting order to the Fleetwood Electric Light and Power Syndicate, Limited. The syndicate undertakes to pay to the Council £600 in consideration of the costs and charges the Council have been put to. The agreement is signed by C. W. Sax for self, and as agent for J. Atherton. A deputation has been appointed.

Glasgow.—Councillor Mackay has been appointed convener of the Glasgow Electric Lighting Committee, in the place of ex-Bailie Burt.

Hammersmith.—The Vestry has resolved to charge 6d. per unit for two hours per day maximum demand, and 4d. per unit beyond, no charge being made for meters.

Hampstead.—The tradesmen of Old Heath Street are petitioning the Vestry to light that thoroughfare by electricity.

Huelva (Spain).—In the Glasgow Court of Session, on Saturday last, intimation was ordered of a petition presented by the Huelva Gas Company (Limited), 115, St. Vincent Street, Glasgow, for confirmation of an alteration of the memorandum of association. The company was formed for the purpose of acquiring the right to light the town of Huelva in Spain with gas, and the shareholders now desire to obtain power to also carry on at Huelva, and elsewhere in Spain, the business of an electric light company in all its branches. The capital of the company is £25,000, which is fully paid up.

Hull.—The Corporation Electric Lighting Committee is prepared to take an improver for two years at a premium of £30. See our "Official Notices."

Limehouse.—By nine votes to eight, the Limehouse District Board of Works has resolved to consent to the County of London and Brush Company's application for a provisional order.

Llanelly.—The Chamber of Commerce considered the lighting of the district the other day, and one speaker said he intended moving that the Chamber call upon the Council to do all they could to introduce electric lighting into the town.

Morecambe.—A Local Government inquiry was held on 13th inst. into the application by the District Council to borrow £26,000 for electric lighting, and various other sums.

Oban.—The high price of gas in Oban (7s. 6d. per 1,000 feet) has led to an agitation for the immediate introduction of electric lighting.

Ogmore Valley.—The company's plant has been found insufficient, and a new 500-lighter is to be put down.

Provisional Orders.—The *London Gazette* of 13th inst. contains notice of applications which are to be made for provisional orders by the Fulham Vestry, Redditch District Council, the Bournemouth and District Electric Supply Company for lighting Poole and Branksome; the Blackheath and Greenwich District Electric Light Company for lighting Greenwich and certain parishes in that direction; London Electric Supply Corporation for electric lighting in the City of Westminster, and certain adjoining places; the Southampton Corporation, for extending the electric lighting area; Ventnor District Council, for lighting the district; Wilmslow District Council, for lighting the district; Southampton Corporation, powers to acquire tramways and use electricity or other mechanical power.

South Africa.—The November issue of the *British and South African Export Gazette* contains the following notes:—The electrical plant now under order for the Knight Central mine is as follows:—Two 7½ H.P. electric motors, 8 20-H.P. electric motors, two 30-H.P. electric motors, and two 100 kw. three-phase Oerlikon generators for furnishing the current to the electrically-driven pumps, &c.—A large electrical installation has been ordered for the Witwatersrand Deep mine.—We understand that a large electrical installation will be ordered shortly for the Elephant's Kloof mine.—The directors of the Paarl Central Company have ordered several motors to supply the power for the new supply water pumps on their property.—Mr. J. Hubert Davies, Johannesburg, has received an order from the Rietfontein A Company for two three-phase generators and a 60 H.P. motor.—Messrs. Easton, Anderson & Goolden, Limited, have received an order from the Luipaard's Vlei Estate Company for a 35 B.H.P. main and tail hauler with motors and dynamos, and also two 12-B.H.P. motors, two 50-unit dynamos, and one 18-unit dynamo and engine for lighting purposes, with switchboards, fittings, and all accessories, being part of a large order for machinery just placed with Messrs. Easton, Anderson & Goolden, Limited. The same firm have also got in hand for the Cassell Coal Company a 20-unit dynamo and a 28-B.H.P. motor.

We understand that the Lighting Committee of the Maritzburg Corporation has recommended the immediate adoption of a system of street lighting by electricity.

St. Pancras.—The Electricity Committee report that the best means for preventing interruptions in the supply will be to rearrange the whole of the present high tension arc lamp circuits, and connect each alternate lamp to the low tension mains. The Vestry has agreed to this at a cost of £2,615 odd.

Thanet.—The Thanet Board of Guardians has been gathering information with a view to the better lighting of the workhouse, electric lighting being specially considered. Several members are in favour of incandescent gas, but the Council has adjourned for fourteen days.

Torquay.—The Town Council has received about 47 tenders for the various electric lighting contracts. They have been referred to Sub-Committee.

Train Lighting.—The Royal train in which H.M. the Queen travels to and from Scotland has just been improved in several ways by the London and North-Western Railway Company. The carriages were formerly lighted by oil, but incandescent electric lamps are now used, current being supplied from accumulators under the floor.

Whitechapel.—The Guildford Electricity Supply Company have withdrawn their application for a provisional order to light the district by electricity.

Works Lighting.—Mr. Bundy has introduced the electric light at his works at Lattersey Field, Whittlesey. The dynamo is driven from the main shaft in the engine shed. Messrs. Grundy and Co., of Cambridge, carried out the work.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Belfast.—The Town Council is to be recommended to give their sanction to the Tramway Company to introduce electric traction, subject to certain increased terms of rental.

Bridlington—Flamborough.—The Flamborough Parish Council has approved of the proposed electric railway between these two villages, and considers that the line would be a great boon to the neighbourhood.

Bristol.—The Joint Committee went thoroughly into the reports, to which we refer somewhat fully on pages 681 and 682, and appeared on the whole favourable to the extension of the trolley system in Bristol in certain districts, but the districts were not defined. It was decided to submit the matter to the Electrical Committee, for them to report what works are necessary for the supply of electricity for traction purposes, and the probable cost. The meeting will, it is understood, report to the Town Council that consent to the Tramway Company extending their electrical system shall be dependent on the current being supplied by the city.—With regard to the supply of power by the Municipality, the company have determined to oppose it utterly; it is stated that they will abandon the scheme rather than have dual control.

Cork.—The Judicial Committee of the Privy Council met at Dublin Castle last week, and considered the application for authority to construct electric tramways (seven or eight miles long) in the City and County of Cork. The Committee decided to recommend the scheme.

Coventry.—The employés of the Coventry Electric Tramways, Limited, held their annual supper on 12th inst.

Electric Power in Westralia.—A project is on foot for the supply of electric power to the Westralian gold fields. Lord Kelvin and Prof. (?) Brown (Switzerland) have given their attention to and approved the scheme in question, which has been brought under the notice of the general public and the Government of Western Australia by Scottish Westralia, Limited, who, last year, obtained permission to utilise the Perth-Coolgardie railway track for the erection of poles to convey electric power to the fields. In order to prove their *bonâ fides*, says *Westralia*, and as an earnest that the undertaking would be carried to completion, the company at that time deposited with the Colonial Treasurer a sum of £2,500. Nearly a year has elapsed since this was done; and, meanwhile, we understand the scheme has been carefully elaborated and improved, until the directors estimate that they will be in a position to generate, transmit, and sell electric energy upon the fields at the rate of 5s. per horse-power per day, instead of 10s. per day, as was estimated last year. Every necessary preliminary has now been completed, and options over private lands, and the requisite riparian rights for the generation of the electric power, have been secured at Newcastle and Northam, while powers have been sought to enter upon Crown and private lands, to erect poles thereon, and to carry overhead electrical conductors across any such lands. The Electric Supply Company intends to meet the wishes of those mine managers who desire to run their mills uninterruptedly night and day by a continuous supply of electric power available as and when required. The above-mentioned rate of 5s. per horse-power per day is reckoned as equivalent to about 5s. per ton of ore crushed.

Electrical Carriage.—The first electrical carriage of the London Electric Cab Company was started from the Royal Hotel, Blackfriars, at midday on Monday.

Germany.—The tenders submitted to the municipal authorities of Cologne for the construction and working of electric tramways in the town were opened on the 7th inst. It was found that six tenders had, in all, been received, two of which were rejected, they being not in conformity with the conditions laid down. The names of the four tendering concerns were:—(1) The Cologne Tramways Company, in conjunction with Messrs. Schuckert & Co., of Nuremburg, and the Union Electrical Company, of Berlin; (2) Messrs. Siemens & Halske, of Berlin, in conjunction with the Helios Company, of Ehrenfeld, Cologne, and Messrs. Havestadt & Contagu, of Berlin; (3) the Allegemeine Electricitäts Gesellschaft, of Berlin; and (4) Messrs. Felix Singer & Co., of Berlin. The tenders were referred to the Tramways Committee for consideration and report.

Italy.—In accordance with a wish expressed by Mr. Dosse, the Queen's Director of Continental Journeys, the municipality of Nice has instructed the Nice Electric Tramway Company to remove the rails from the Avenue Victoria, and to replace them on the Eastern Road, thus, says the *Times*, diverting the traffic from the vicinity of the western wing of the Hôtel Cimiez.

Notice!—In connection with the electrical cab and omnibus movement, the Electric Motive Power Company, Limited, has given notice in the daily press that legal proceedings will be instituted against all persons infringing their patent rights relating to electric cabs and omnibuses.

Paris.—Electric traction is not being very rapidly developed in Paris. There are, in fact, only the accumulator lines of St. Denis and the Claret-Vuillemeier line. While waiting for the omnibus company to decide upon adopting some system, either overhead or underground, we can mention some new accumulator lines starting from the middle of Paris and extending into the suburbs. We may notice, among others, the new lines of Madeleine-Courbevoie, Madeleine-Bineau-Courbevoie, Madeleine-Levallois, Neuilly-Avenue du Roule. These tramways use rapidly charging accumulators of the Tudor type, the weight being 15 kg. of plates per element. The batteries are recharged on the car at the terminus by means of a circuit at 540 volts from the station which has been established at Puteaux by the Industriel Steam and Electro-motor Company. The charge is performed in 15 minutes at a strength of 120 amperes, or about 8 amperes per kilogramme of plates. The whole battery consists of 200 elements with five plates, two of which are positive and three negative, at a mean capacity of 32·5 ampere-hours. This charge is sufficient for an out-going and return journey of a length of about 7 kilometres, on condition that the speed does not exceed 12 kilometres an hour in Paris and 16 kilometres out of Paris. The installation and trials of these new tramways have just been completed.

South Africa.—A correspondent wrote from Port Elizabeth on the 26th ult.:—"The works of the Electric Tramway Company are being quickly built on a site at the south end of the town, while the laying of the tram lines is progressing rapidly."

South Staffordshire.—At the monthly meeting of the Sedgley District Council, on Tuesday, Mr. Sellon, representing the British Electric Traction Company, attended, and explained to the members what his company proposed to do after acquiring certain tramways in the South Staffordshire district. He stated that the object of the formation of the company was that of carrying out tramways in all parts of the country and utilising electricity. The undertaking was a very large one. It embraced the whole of the South Staffordshire district, including the Wolverhampton district, Stourbridge district, and Dudley district. They proposed to buy up the Dudley and Wolverhampton Tramways, Wolverhampton Tramways, South Staffordshire Tramway, and the Dudley and Stourbridge Tramway Companies. The company were presenting a Bill in Parliament this year for the purpose of uniting all the various systems. There would be one uniform gauge throughout, which was not the case at present, and one uniform system. If the scheme was to be carried out in its entirety, it would mean nearly a million of money being spent in this district alone. The purchase of the companies he had mentioned, and the reconstruction, would be heavy. It would probably cost £5,000 per mile to lay the lines. It was agreed to have the company's terms in writing before the Council came to any decision.

The Trip to Brighton.—We hear that the report of the Motor Car Club Committee awards gold medals to the first eight motors that arrived in town, and states that, in view of the unfavourable circumstances, the fact that 20 motors out of 22 which left Brixton, arrived at Brighton during the evening without accident, constitutes a feat far exceeding their most sanguine expectations. After the run the cars, with the exception of their muddy state, were in perfect condition, and ready to take the road again.

Weston-Super-Mare.—Mr. Brereton, C.E., explained to the District Council the other day that it was proposed to apply to Parliament for a Bill to authorise the construction of an electric tramway within the district.

Withington.—The Manchester Carriage and Tramways Company have reconsidered their scheme of extension of tramways in the Withington districts, and have decided to amend the same by leaving out the proposed tramways along Edge Lane, from Stretford to Barlow Moor Road, and along Lapwing Lane and Burton Road, and also the portion of Barlow Moor Road between Burton Road and Wilmslow Road. The Company asked the Council to consent to their proposed application for a provisional order for power to construct the remainder of the lines on the Company undertaking to transfer the power to construct to the Council and agreeing to a clause to that effect being inserted in the order. The Council decided not to assent to such application, but make application themselves for a provisional order to construct additional tramways along certain streets in the district. It was further resolved that the Electric Supply Company, in addition to the powers it now possessed as regarded the application for a provisional order for an electric supply, should have full power to decide as to the tramways to be included in such application for additional tramways, and take all necessary steps to deal with matters of detail in connection with the application.

TELEGRAPH AND TELEPHONE NOTES.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Brest-St. Pierre (Anglo, 1869)	April 6th, 1895 ...	...
Puerto Plata-Martinique ...	Dec. 19th, 1895 ...	...
Amazon Companies cable beyond Parintius	May 5th, 1896 ...	...
Para-Maranham	Oct. 8th, 1896 ...	...
Landlines.		
Trans-Continental line beyond Mazol	March 12th, 1896 ...	...
Carthagena-Barranquilla (Columbia)	July 4th, 1896 ...	...
Saigon-Bankok ...	Nov. 15th, 1896 ...	Nov. 15th, 1896.
	Nov. 17th, 1896 ...	...

The Dongola Telegraphs.—In Major-General Sir H. H. Kitchener's despatch dated Dongola, September 30th, which appeared some days ago in the *London Gazette*, the following paragraph appears:—"The railway and telegraph services were very efficiently performed under the respective direction of Lieutenant Girouard, Director of Railways (Royal Engineers), and Lieutenant Manifold, Staff Officer of Telegraphs (Royal Engineers). The construction of 110 miles of railway, and 250 miles of telegraph during the very trying summer, and in difficult country, involved much labour and constant supervision on the part of these officers and their assistants."

The Telephone in Fife.—Estimates for the erection of an independent telephone system has been considered by the Fife County Council. Inquiries are being made as to wayleaves.

The Trunk Lines.—The Durham County Council has passed a resolution to the effect that the present arrangements as to trunk lines is most unsatisfactory.

Amateur Diplomacy.—In a recent issue of the *Pall Mall Gazette*, there appears an instructive article concerning British prestige in Persia, written by an "Eastern Traveller," in which the following paragraph occurs, as partially explanatory of the waning of English influence in Persia. The writer here takes it for granted that the British Legation at Teheran is in the wrong. This supposition is not necessarily a correct one:—"In recent times the slackness of the British Legation at Teheran has been largely responsible for our loss of position. Teheran is not a picnic legation, and the Minister there, to be successful, must necessarily be a strong man cast in Oriental mould. But for years the Foreign Office has been divided in opinion between regarding the Legation as a legitimate reward for a brilliant Anglo-Indian, and using it as a dumping-ground for a diplomatist of untried calibre. The latter is rarely in touch with the peculiar British interests in Persia. The influence exerted, for instance, by the Indo-European Telegraph officials was a long-standing cause of friction with the Legation. The history of the telegraph would comprise as sorry a list of studied slights and continued bickerings as ever dissipated forces that might have worked for good. Had the wire been controlled by a Russian Company, the enormous influence and peculiar knowledge that the officials have exerted and possessed, would have been at the disposal of the empire. As it is, paltry friction has done its work, and until the last few years the Legation and Telegraph Company have been almost at open enmity. The unfriendliness existing between the Telegraph Company and the Legation has been a fair sample of the prevailing attitude of the latter body to all British institutions in the country."

International Telephonic Communication.—It is stated that the necessary preliminary arrangements for the erection of a direct telephone line between Budapest and Berlin have just been completed. The work will be taken in hand next spring, and it is hoped to complete the line by September, 1897.

Telegraph Rates to India and the Far East.—Last week, the India, China, and Colonial Committee of the Manchester Chamber of Commerce, reported that they had had before them a letter from the London Chamber of Commerce informing the Manchester Chamber that it had been decided by the former body to address a letter to the Secretary of State for India urging that the Indian Government should follow the precedent set by the Governments of Australasia and Cape Colony, by giving a guarantee to the telegraph companies interested against any loss which might be sustained by them in consequence of a reduction of rates. The Committee, being of opinion that a reduction of telegraph rates would be primarily for the benefit of the mercantile community trading with India, had been unable to see its way to support the representations of the London Chamber. The Board adopted the views of the India, China, and Colonial Committee. It was resolved to thank the London Chamber for the opportunity which had been courteously afforded of discussing its representations.

The following, which appeared in the *Rangoon Gazette* last month, also shows that a reduction of rates to China is much to be desired:—

"An agitation, of which we shall probably hear much in the near future, has started in the Far East in connection with the rates charged by the telegraph cable companies. The whole tendency of recent years has been to reduce these rates. It is not easy to bring about a reduction, as our Chambers of Commerce in India well know, for they have been agitating for years for a reduction in the rates for telegrams between India and Europe, but at least their demands for a lowering of the rates have not been answered by a heavy increase. This is what has just happened in the Far East, for rates have suddenly been raised 37½ per cent. on the home cables and no less than 100 per cent. on local cables. The suddenness of the change seems to have taken away the breath of the commercial community in Hong Kong and China, but they are now gradually recovering, and vehement protests are being uttered at Shanghai, Hong Kong and other places. The arrangement has been come to by the Chinese authorities and the cable companies. It is hopeless to attempt to bring public opinion to bear on the former, and as the latter enjoy a monopoly, they are not amenable to discipline, but the British Foreign Office, who sanctioned the arrangement, and the British Minister in China, who presumably was consulted in the matter, are catching it hot. The objections to the great increase in the rates are many, but the principal complaint of the British merchant in the East is, that he has never been consulted in the matter, and that, till the change was an accomplished fact, he, the person most vitally interested, had not an opportunity of expressing his opinion on it. That is a reasonable complaint, and one which will find abundance of support in England. Now, when unexampled efforts are being made in every direction to foster British trade, one would have thought that Lord Salisbury would not have assented to a complete revision of the cable tariff in the Far East, without making inquiries of the probable effect of the revision on British trade. But worse remains behind; and if the assertion made by the Shanghai Chamber, that differential rates have been introduced, is accurate, the strong language used in the Treaty ports and Hong Kong, and to judge from the papers of the Far East, much strong language is being indulged in, is more than justified. Messages sent by Europeans, it is said, are charged at twice the rate of cables sent by Chinese. If this is correct, the Shanghai Chamber's demand for 'prompt and effective redress' is not only justifiable, but when the facts become known in England, it is certain that such pressure will be brought to bear on the Foreign Office by public opinion that the cable companies and the Government of Peking will be induced to at least abolish the differential rates. It passes the wit of the 'plain man' to understand how the Foreign Office could ever have sanctioned such inequitable treatment, or how a cable company, directed and owned by British, could have thus agreed to handicap British merchants."

Pretoria—Johannesburg.—A correspondent writing from Johannesburg, on 22nd ulto., stated that within a few months telephone communication will be established between that town and Pretoria.

The Pacific Cable Scheme.—The Pacific Cable Committee held its first meeting for the taking of evidence at the Colonial Office on 13th inst. Lord Selborne, one of the British delegates and Chairman of the Committee, presided, and there were also present Mr. G. H. Murray (the second British delegate), Sir Donald Smith and Mr. Jones (Canadian delegates), Sir Saul Samuel and Mr. Duncan Gillies (Australasian delegates), and Mr. W. H. Mercer, of the Colonial Office (secretary). The only witness examined was Mr. Sandford Fleming, C.M.G., who attended some of the preliminary meetings in the capacity of technical adviser to the colonial delegates. It has been decided that, so far as future meetings are concerned, no official communication will be made to the Press, either as to the nature of the evidence or the identity of the witnesses examined; but with regard to last Friday's proceedings, the Press Association states that Mr. Fleming's evidence was entirely in favour of a scheme for connecting Britain with Australasia by means of an "all British cable." Mr. Fleming is said to have been the first person to suggest a Pacific cable for the connection of Canada with the Australasian colonies; and Sir John Macdonald, to whom he communicated his ideas, submitted the scheme to Lord Beaconsfield, upon whom it is said to have made a very favourable impression. At the London Conference in 1887, and at the Ottawa Conference in 1894, Mr. Fleming explained his ideas on the subject, and the results have been officially published. His evidence before the Committee last week was in precisely the same direction, and his examination by the delegates was of considerable length.

CONTRACTS OPEN AND CLOSED.

OPEN.

Ayr.—November 25th. Tenders are invited for the supply and erection of the following plant, for the Electric Lighting Committee; two Lancashire boilers and fittings, mechanical stokers, extensions to economiser, two 200-kilowatt steam alternators and condenser, cables and culverts. The ground plans of plant and specification, with terms and conditions of tenders and contract, may be obtained at the offices of Mr. Robert Hammond, the consulting engineer to the corporation, Ormond House, Great Trinity Lane, London, E.C., on and after November 10th, on payment of a deposit of £2 2s. for each copy.

Denmark.—December 4th. Tenders are invited by the Municipal Authorities of Copenhagen for the supply and erection of the necessary boilers, engines, dynamos, mains, &c., required in connection with a projected central electric lighting station at Vesterbro. Tenders to be directed to the Fourth Division of the Magistracy, Copenhagen.

Deptford.—November 30th. The Commissioners of Baths and Washhouses for the Parish of St. Paul, Deptford, invite tenders for proposed electrical installation at the Deptford Public Baths now in course of erection. Particulars of Mr. Thomas Dinwiddy, architect, Greenwich, and at Whitehall, S.W.

France.—November 26th. The French Post and Telegraph authorities invite tenders for the supply of 14 tons of tin solder, and 50,000 telegraph pole brackets. Tenders to be directed to the Sous-Secretariat d'Etat des Postes et des Telegraphes, 103, Rue de Grenelle, Paris.

Londonderry.—December 1st. The Corporation wants tenders for the supply of carbons for one year, from January 1st, 1897. Particulars to be obtained from Mr. John Christie, city electrical engineer, Guildhall.

Maryborough (Ireland).—November 23rd. Tenders are invited for the supply and erection of an electric light installation at Maryborough District Lunatic Asylum. Tenders should be sent to the secretary, Board of Control, Customs House, Dublin. Specifications, &c., will be issued on application to the Office of the Board of Control of Lunatic Asylums, Customs House, Dublin, on deposit of £3 3s. Plans can be seen at the office of the electrical engineer, Mr. Walter Leake, 35, Dame Street, Dublin.

Oldham.—November 25th. The Finance Committee want tenders for wiring the Borough Accountant's Office for 32 lamps. For particulars see our "Official Notices."

Servia.—November 27th. The Ministerium für Bauten at Belgrade, Servia, are inviting tenders for an installation of electric lighting in the Imperial National Theatre in the Servian capital. Tenders to above.

Southampton.—December 4th. Tenders are invited by the Corporation for the supply and laying of insulated electric mains, conduits, and drawing-in boxes. Further particulars from Messrs. Kincaid, Waller & Manville, and our "Official Notices."

Southampton.—December 4th. The Corporation invites tenders for the erection of buildings for an electric generating station. Engineers, Messrs. Kincaid, Waller & Manville.

South Shields.—November 23rd. The Corporation want tenders for the supply and erection of alternator, engine, transformers, rectifier and extension to switchboard.

Spain.—November 29th. The Municipal Authorities of Valdepeñas (Cuidad Real province) are inviting tenders for the concession for the electric lighting of the public streets of the town. Tenders to be sent to the Secretariat del Ayuntamiento de Valdepeñas (Cuidad Real).

St. Olave's, Southwark.—November 23rd. The Board of Works invites tenders for the purchase of a dynamo and accumulators, which may be seen at the Stone Yard, Vine Street, Tooley Street.

West Ham.—November 24th. The Council invites tenders for four steam alternators, mains, transformers, arc lamps, crane, &c. Particulars from the Borough Electrical Engineer (Mr. John J. Steinitz), Town Hall, Stratford.

West Looe (Cornwall).—November 28th. Tenders are invited for the lighting of the parish with either gas, oil, or electricity, for the Parish Council. Information may be obtained of Mr. William Hicks, hon. clerk.

York.—November 30th. The Corporation invites tenders for the supply and erection of a complete electric lighting plant for the Borough, also supplying and laying mains, ditto arc lamps, and running the whole system. Further details from Prof. Kennedy.

York—November 23rd. The directors of the North-Eastern Railway are prepared to receive tenders for the undermentioned articles in such quantities as they may require during the six months ending June 30th, 1897, delivered carriage paid at the company's telegraph stores at York: 1. Telegraph apparatus; 2. Telegraph wires and line stores. Forms of tender may be obtained on application to Mr. Graves, Telegraph Department, York.

CLOSED.

St. Pancras.—The Vestry has accepted the tender of Mr. T. E. Kershaw for supplying and erecting arc lamp pillars (at £8 5s. each) required in the Haverstock Hill extensions.

Birmingham.—Messrs. Mavor & Coulson have secured the contract for the electric installation of the Birmingham Dead Meat Market, the price being £7,877. Crossley gas engines will be put in.

OBITUARY.

William James Tyler.

It is with a deep sense of regret that we announce the death of Mr. W. J. Tyler, the secretary of the India Rubber, Gutta Percha, and Telegraph Works Company. Respected—aye, and, in this instance, we might say beloved—by all who had to do with him, his demise will come as a great shock to many. It is the character of the man that we especially desire to keep before us. His extreme fairness and never-failing courtesy may be called vividly to mind. The deceased exhibited rare qualities and instincts throughout his lifetime. He would always have a kind word of greeting for everyone, quite irrespective of the favours of this world, or of benefit to himself. We venture to think that in some respects Mr. Tyler was wasted on matters pertaining to business, electrical or otherwise, and that his cultured manner would have had more scope in the diplomatic service. It is difficult to recall anyone more truly typical of the word gentleman, in its real sense, than William James Tyler.

We will now lightly review the manner in which his life has been taken up. In 1870-71 the subject of our obituary served with those who went to aid the wounded during the Franco-German war. Thus employed, he won the esteem of his fellow workers, amongst whom were General Sir Henry Brackenbury, G.C.B., Sir Vincent Barrington, and Dr. (afterwards Sir William) MacCormac. Of his many acquaintances who will be sorry to hear he has left us, are Mr. Archibald Forbes and other war correspondents present during that fearful campaign.

A vacancy occurring in the secretaryship of the Silvertown Company on the resignation of the late Mr. J. A. Brand, our subject was appointed to the post at the end of 1871. This important and responsible position he has graced with conspicuous advantage to all, up to the lamented day of his death.

In 1872 the Cape of Good Hope Colonies were agitating for telegraphic communication with the rest of the world, and Mr. Tyler was despatched by the Silvertown Company to these Colonies and to Mauritius, with a view to arranging for the establishment of a submarine telegraph system along the East African Coast. The *inertia* of Government departments often being great—owing to the unavoidable ignorance of those who deal with such matters—this mission brought no immediate result. However, the good seed sown at this period by Mr. Tyler, Mr. John Coles (representing Messrs Hooper & Co.), and by the agents of the Telegraph Construction and Maintenance Company, bore fruit some seven years later in bringing about the laying of the cables which now connect the Cape of Good Hope with Europe *viâ* Aden. These lines are the property of the Eastern and South African Telegraph Company, which has been a success from the day of its foundation, both as an investment and as an instrument of public utility. During Mr. Tyler's absence on the mission above alluded to, the endless worry attending work of this character laid him open to an attack of Mauritius fever, such as undermined his health for a considerable period.

In subsequent years he has been constantly engaged in the ordinary routine and highly responsible work connected with the important and very general business of the Silvertown Company.

Mr. Tyler had been in failing health for some months past, but no one foresaw that the end was so near. The deceased was in his 61st year, and leaves a widow and three daughters, to whom we tender our sincere sympathy. Many friends and fellow workers testified to their high appreciation of the worth of the deceased by attending the funeral service at Kidbrook Church, Blackheath, as well as subsequently at the burial in Charlton Cemetery. In our opinion the best features of a man are tested with his own family, and here, we think, the deceased must have outshone many who might have been his equal in public. His genuineness and simpleness of character always suggested this; and it is such landmarks that we prefer to remember in those who, to our grief, have left us.

Mr. Tyler was an enthusiastic Churchman, and the good service he has done will not easily be forgotten.

NOTES.

Errata.—In Mr. Raworth's paper, part of which we published last week, for "coal and labour combined," line 28, left-hand column, page 648, read "coal;" for "increase in economy," line 50, right-hand column, same page, read "increase in apparent economy;" and lastly, for "thermal and electrical," line 34, page 649, read "thermal, mechanical, and electrical."

The Electro-Harmonic Society.—So thoroughly did the members of the Electro-Harmonic Society appear to appreciate their last "smoker," that the musical directors have determined to reproduce a portion of the programme for the "ladies' night," on Friday evening next. The full list of artistes and their selections can be found in its usual position amongst our advertisement columns.

Made in Germany.—A correspondent writes:—"I am being continually pestered by F. C. Koch, of Hohenlimberg, and his patent ventilated dynamo brushes, the 'best and cheapest on the market!' He is now evidently quite willing to compete with our own manufacturers, as the following quotation which concludes his letter clearly indicates:—'If, on account of the seemingly lower price, you should prefer brushes made of ordinary wire gauze, kindly let me have, in addition to stating the length, width, and thickness of the brushes, a sample of the material those you now use are made of, that I may examine same and calculate the price accordingly.'"

Obituary.—On Monday afternoon, Mr. Robert Silk, who had been connected with the Bradford Electricity Works since their inauguration, was buried at Undercliffe Cemetery. Numerous tokens of sympathy and esteem in the form of wreaths were sent by the Electricity Committtee, the staff at the supply station, and the Town Hall officials. Among the mourners were Mr. A. H. Gibbings (the Borough electrical engineer), and Mr. S. Dalton, the assistant engineer. There were about 60 Corporation employés in the procession.

Atmospheric Electricity and Telephones.—An interesting paper by Trabert, on the crackling of the telephone on the Sonnblick, appears in the Fourth Report of the Sonnblick Verein. The Sonnblick, it may be stated, is one of the best known mountain observatories in the world, by reason of its height (10,154 feet), and especially by reason of the valuable results which have been derived by Hann and others from the observations there made. For six years, says *Science*, five observations a day have been made of the intensity of the crackling in the telephone at the summit. It appears from these data that in December the minimum crackling is at noon, with the maximum at 9 p.m., and a secondary maximum at 7 a.m., while in June there is a steady increase in the intensity of the noise from 7 a.m. to 9 p.m., without a noon minimum. The other months of winter and summer follow respectively the same rule as December and June, while the intermediate months, as expected, present the intermediate conditions. Further, the noise is greater in summer than in winter. Regarding the explanation of these phenomena, the author finds it chiefly in the presence of atmospheric electricity in the clouds over the Sonnblick, for there is a very striking correspondence between the crackling and the cloudiness on the summit, not only in the diurnal period, but in the annual as well. The days on which there is the greatest intensity of crackling are almost invariably distinguished by cloudiness, rain, snow or thunderstorms. The part played by earth currents must not be overlooked, for on one cloudless anticyclonic day there was a very well marked crackling, which could not be explained as being due to atmospheric electricity.

Institution of Electrical Engineers.—The following is a list of the members nominated by the Council for office in 1897, as announced at the ordinary general meeting, November 12th, 1896:—

As President: Sir Henry Mance, C.I.E., M.Inst.C.E.

As Vice-Presidents (remaining in office):—Robert Kaye Gray, Prof. S. P. Thompson, D.Sc., F.R.S. New Names: Prof. John Perry, D.Sc., F.R.S.; Joseph W. Swan, F.R.S.

Ordinary Members of Council (remaining in office):—G. von Chauvin, Henry Edmunds, S. Z. de Ferranti, W. E. Langdon, Prof. J. A. Fleming, M.A., D.Sc., F.R.S.; Dane Sinclair. New Names: S. L. Brunton, Prof. J. A. Ewing, F.R.S.; W. P. J. Fawcus, Major R. Hippisley, R.E.; E. Manville, J. S. Raworth, M.Inst.C.E.; Herbert Taylor, M.Inst.C.E.; James Swinburne, M.Inst.C.E.; Charles Henry Wordingham.

Associate Members of Council (for re-election):—Captain W. P. Brett, R.E.; H. W. Miller, Sidney Morse.

Officers nominated by Council for 1897:—As Honorary Auditors (for re-election): Frederick C. Danvers, Augustus Stroh.

As Honorary Treasurer.—New Name: Prof. W. E. Ayrton, F.R.S., Past-President.

As Honorary Solicitors (for re-election).—Messrs. Wilson, Bristows and Carpmael.

Journalistic Enterprise.—The following cutting is from our contemporary, *Electricity*:—

£10 Free Insurance for all our Readers. £10

The Proprietors, Messrs. S. RENTELL and COMPANY, will pay the sum of TEN POUNDS (£10) to the next of kin of any person who may be killed by Accident through Electric Shock in the United Kingdom, provided that a copy of the current issue of this paper be found upon the deceased at the time of such accident; and also provided that within seven days of such death notice thereof be forwarded to the Proprietors at their offices, No. 11, Ludgate Hill, London, E.C., together with satisfactory proof that the deceased met his or her death by such Electric Shock.

Why live and be miserable as an unemployed electrician, when, for the small investment of one penny, you can make arrangements so as to shuffle off this mortal coil painlessly and instantaneously, and at the same time benefit your next of kin?

More Conduits.—A company entitled the General Electric Traction Company has been formed in France for the purpose of pushing in that country—also in Italy, Spain, and Russia—the electric traction patents taken out by Mons. Diatto, who has for some time past been endeavouring to perfect a closed conduit system on the magnetic switch plan. We described his system some months ago.

Substances Sensitive to Radiant Heat.—Dr. Liesegang has published a list of some of the most important cases of sensitiveness to weak radiations of heat. Paper saturated with cupric bromide or a mixture of sulphate of copper and potassium bromide has a faint greenish tint, which becomes olive brown under radiant heat, and if a wooden fretwork is used as a screen, a brown image can be obtained in a minute by exposing to the radiations from a gas stove, and on treatment with silver nitrate this image becomes black by reason of the reduction of the silver. Bichromated paper is affected by radiant heat as by light, and paper impregnated simply with sulphate of copper yields a feeble image, which becomes nearly black when treated with silver nitrate. A mixture of sulphate of copper and oxalic acid gives a paper which becomes brown on exposure, and chlorate of copper is very sensitive to faint blue, becoming deep green. Similarly used, bromide of tin behaves as if exposed to light; the unexposed parts becoming very black when treated with silver nitrate. Nitrate of silver, says a New York exchange, is slightly browned, and the tint is deepened by acid hydroquinone or gallic acid. Nitrate of lead gives a yellow image, which is reddened on treatment with silver nitrate.

Electricity in Chemical Researches.—A new method of research has recently been devised by W. Lob, who proposes to apply it more especially in investigations into organic chemistry. He says that many reactions which occur under the influence of an electric current can be carried out in a convenient manner by so arranging the reacting substances that they make up a galvanic element. Thus, when a porous cell filled with a solution of nitrobenzene in concentrated sulphuric acid is put into a solution of dilute sulphuric acid, a piece of platinum placed in the nitrobenzene solution, and a piece of zinc in the dilute sulphuric acid, and the two metals then connected, the nitrobenzene is rapidly and completely reduced to amidophenol. In a similar manner orthonitrobenzoic acid dissolved in an alkali may be reduced to azoxy and hydrazo-benzoic acid. Many other reactions can be carried out, in a similar way. The original paper in which the new method is described may be found in the *Berichte der Deutschen Physik und Chemie*.

Lectures.—Prof. Everett opened the winter session of the Belfast Natural History and Philosophical Society, on 3rd inst., with an address on the subject of "Recent Advances in Electricity."

An exhibition of lighting, cooking, and heating by electricity, was given recently by Mr. Donnison and Mr. Harrison, electrical engineers, of London, at the Liverpool Junior Reform Club, before the committee and a large number of members. Steaks, omelets, &c., were cooked by the *chef* of the club, and pronounced by gentlemen present to be vastly superior to those produced by the ordinary process. The demonstration was followed by a lecture and experiments in artistic decorations as applied to electric lighting.

Electrically Driven Fans.—"Counterblast" writing to *Engineering* points out what seems to him an extraordinary statement appearing in a recent article in our contemporary on the above subject. "The fans are said to be delivering 200,000 cubic feet per minute, *i.e.* (I suppose), 50,000 each, and that the power absorbed when working is = 840 watts = $1\frac{1}{3}$ horse-power (nearly). What I wish to draw your attention to is the extraordinarily small amount of power compared with the work done—which I consider will run out at about 6 horse-power theoretical. Am I right, or is this some new device after the manner of perpetual motion?"

Damages.—The *Galignani Messenger*, of the 8th inst., says:—"A case was before the Correctional Court of Paris yesterday, which should warn the managers of establishments where electricity is used to be doubly careful. M. Miet, it appears, is the director of a factory on the left bank of the river, and last March had some repairs to the electrical machines carried out, in the course of which one of the workmen employed was killed by an electrical discharge. The death occurred, as was clearly proved, through the negligence of the director, and he was yesterday condemned to pay a fine of 500 francs."

The Insulation Resistance of a Street Railway Cable.—In another column will be found a communication from Mr. Charles Hewitt on "The Insulation Resistance of a Street Railway Cable," reproduced from the *Electrical World*, in which is described, says our contemporary, an extremely simple and practical method of making such measurements in an ordinary electric railway power station. The means employed is simply to connect the insulation resistance in series with a voltmeter across a low potential, and knowing the resistance of the voltmeter from its indicated deflection, the insulation resistance may be readily calculated. Assuming the potential constant, our contemporary continues, Mr. Hewitt takes the deflection, which is, say, 550 volts. This deflection is proportional to the current flowing in the instrument. If, on reconnecting the latter in series with the insulation resistance, any other deflection is obtained, it is evident that the combined resistance of the system must be greater in inverse ratio to the two deflections, and subtracting the voltmeter resistance, the insulation resistance is at once obtained. It may be said, however, that in making such measurements, it is important that the voltage does not vary, otherwise the results will be erroneous. In fact, it would be better to take the voltage at the bus bar terminals with one voltmeter, and take simultaneous readings with a testing voltmeter. If only one voltmeter is at hand, a special arrangement of switches should be provided to instantly shift the connections. The method suggested of locating a fault is quite accurate, and if properly applied, is sure to find the difficulty with precision and despatch, but it involves the cutting of the cable in one or more places, and the subsequent annoyance of making joints. Inasmuch as the cable is entirely disconnected from the system, and therefore is not used, it would be better to send through it a strong current independently of the loaded machines. Let the lineman take with him a low-reading voltmeter, and, selecting a place, measure off a definite length of cable, being careful that this length includes no joints. The insulation may be pierced by pins, thus making contact with the metallic core at selected points, and assuming the resistance of the cable to be a certain amount, the voltmeter deflection is proportional to the current flowing in the cable. By repeating the experiment in other places, the point will soon be found where the current is notably less than before. It will then be evident that the leakage occurs between the last two points tested, and by gradually approaching from either direction in much the same way as in Mr. Hewitt's method, the fault may be located without cutting the cable, an important consideration. Of course, it is necessary for the attendant at the station to keep the current on the cable absolutely constant, and for the lineman to measure off exactly equal lengths of cable in making his tests, at the same time securing good contacts where the insulation is pierced. Due care must also be taken to note any change in the size or the type of cable, so that these factors can be taken into account in making the measurements. The high resistance instrument mentioned by Mr. Hewitt is an extremely convenient accessory in any testing equipment, and it is surprising that it is not possessed by more having occasion for its use. With such an arrangement an actual voltmeter containing the moving parts can be made to deflect with a very small voltage, and thus be useful in such tests as have just been alluded to. The resistances to be measured can be sub-divided into multiple parts, so that the instrument may be used with accuracy over a wide range of voltages.

Electric Clocks.—On Wednesday the Glasgow Corporation system of electrically controlled time-pieces was inaugurated. The clocks will be controlled by one in the Municipal Buildings, which again is in direct connection with Glasgow Observatory. The main clock in the buildings regulates three circuits, and a switchboard, bearing three receiver dials, is fitted up near at hand. Each circuit can regulate as many as 10 clocks, but in the meantime there will be only five on each. To insure the accurate time-keeping of the main clock, it is fitted with a Ritchie pendulum, which receives a current of electricity from the Observatory clock every second. Should the experiment prove satisfactory, between 200 and 300 electric clocks will be put up at the corner of various streets of Glasgow. The system of the Standard Electrical Time Recording Company, of London, is adopted.

Electric Power from Niagara Falls.—A *Times* correspondent at Buffalo, wiring on 16th inst., says :—

At one minute past midnight the Mayor of Buffalo, with a distinguished company of his fellow citizens, announced the formal receipt of electric power from Niagara Falls by a salvo of 21 guns. Twenty-six miles away a tiny leak from the cataract rapids, falling from water level a distance of 175 feet, enters a turbine which drives a vertical steel shaft 22 inches in diameter at the base, diminishing to 15 inches at the bearings, at a speed of 250 revolutions per minute. At the top of this shaft revolves a dynamo developing 5,000 horse-power of electrical energy in an alternating two-phase current of 2,200 volts. Three of these mighty, though almost silent, generators are emitting 15,000 horse-power, supplying energy to half a score of large and successful manufactories producing aluminium, carborundum carbide, and metallic sodium, to the city street lamps, to hotels and private houses innumerable, to the local trolley tram lines, and to the trolley railroad connecting Niagara City with Buffalo and the intermediate town of Tonawanda. At the Niagara power-house the initial electrical energy of 2,200 volts is stepped up by transformers into 11,000 volts, at which the current passes over a pole line carrying three wires for three-phase transmission. On reaching Buffalo it is reconverted and reduced by means of stepped-down transformers to 400 volts of alternating current. It next passes through rotary transformers and becomes direct current suitable for street railway and kindred uses. The first Buffalo customer is the Buffalo Street Railway Company, supplying street conveyance for the entire city of 375,000 souls. It was originally worked by horses, and later by dynamos driven by local steam engines. The latter are now superseded to the extent of 1,000 horse-power out of a total of 7,000 from the cataract of Niagara. The aggregate horse-power from Niagara already contracted for in Buffalo is 10,000. Many manufacturers are anxiously waiting to have their applications accepted. From this it is safe to predict that it is only a question of time, and no very great time, when all of the industries here requiring power will receive it from Niagara Falls, and that the 22 miles separating the two cities will be built solid with smokeless and teeming factories, and that this region will become the greatest manufacturing centre on this continent. It is no small privilege to me to be the only one present not officially connected with the company, remembering, as I do, that never-to-be-forgotten night in New Jersey, when the hand of the wizard Edison caused the pigmy dynamo of that epoch-marking day to awake to life the first incandescent filament bulb, by the rays of which his face was photographed as a souvenir of the occasion. The story of to-night would not be complete without mention of the names of the little group of far-seeing and clear-headed pioneers, Rankine, Stetson, and Wickes, the founders, and the half-dozen courageous capitalists who have poured into what for years seemed but a hole in the ground their millions of money—first, that prince of bankers and philanthropists, Mr. Pierpont Morgan, promptly and confidently followed by Messrs. Mills, Twombly, Adams, Lanier, and Brown. Thus another imperishable laurel is added to the Victorian era.

A Sure Test for Death.—Dr. Hugo Engel, of Philadelphia, writing to our New York namesake regarding the use of the Röntgen rays as a sure test for death, says it is well known that electro-muscular contraction, as elicited by the application of the well moistened electrodes of a Faradic battery to the human body, ceases within a certain time after death, latest, he believes, 90 minutes. That test most are acquainted with. For years, he says, the French Academie des Science kept up the standing offer of a large reward for the discovery of an infallible sign of death, which could be applied by the most ignorant. That reward was given to a Frenchman some 25 years ago. The writer continues :—

When in a darkened room you hold your open hand with finger touching finger in front of a candle light, you will see the bright red colour of the circulating blood shine through the skin where finger touches finger. The Frenchman referred to discovered that this sign ceases the moment death occurs, and a most thorough investigation showed that neither in catalepsy nor in any other variety of apparent death is this sign ever wanting; it disappears only with death. Simple as the sign is, easily as it is applied under the most varied conditions, even by the most illiterate, yet it is the surest indication of that congealing of the tissues, which sets in synchronously with death—it indicates the cessation of life's current of motion. Science knows no more reliable test of death; I doubt whether a simpler will ever be discovered.

If it were a question, somewhere in the wilderness, to determine the question whether death had occurred or not, it might be difficult in procuring X rays—for even I, though living in one of the best quarters of Philadelphia, cannot apply it because of the absence of the electrical current needed, unless I want to take the trouble of a special battery—but a flame, whether from a candle, match, or piece of paper, can always be had, and with it the sure test of death above described.

The Hull Extension Scheme.—Mr. Hammond's report on the proposed extension scheme was before the Electric Light Committee yesterday. He concludes by saying that the scheme recommended by the committee, of high tension feeding from one central works by means of continuous currents, is more suitable for Hull requirements than a high tension alternating system or a low tension system, involving a number of separate works.

Heat-Resisting Qualities of Wired Glass.—The *Journal* of the Franklin Institute recently gave particulars of some tests made to determine the fire-resisting qualities of wired glass, *i.e.*, glass containing in its texture woven wire netting. The information is given in a report to the Philadelphia Fire Underwriters' Association, and the results of the trials showed that glass of this kind is capable of withstanding a high temperature, very much higher than ordinary glass, without melting or losing its continuity, even when suddenly drenched in a heated state in cold water. The conclusions drawn from the tests, and given in the report, are as follows:—1. Wired glass can safely be used in skylights, and in such situations will stand a severe fire, and not give way when water is thrown on it. A wooden framing for skylight, covered with tin, all seams lock-jointed and concealed nailed, is superior in fire-resisting quality to iron framing. 2. Wired glass in wooden sash, covered with tin, all seams lock-jointed and concealed nailed, can safely be used for windows toward an external exposure. 3. Wired glass can safely be used in fire doors to elevator shafts and stairway towers, where it is necessary to light said shafts. 4. In office buildings, hotels, &c., where it is undesirable to have elevator shafts entirely enclosed and dark, wired glass permanently built into a brick or terra-cotta shaft, or arranged in a wood metal-covered frame, can safely be used. 5. Wired glass plate, securely fastened in standard fire shutters, can safely be used toward an external exposure. In this case, the fact that a possible fire in a building, all windows of which are protected by fire shutters, can much more readily be detected from the outside through the wired glass, is of importance. The capability of the wired glass to withstand a temperature beyond the melting point of glass appears, says the *Scientific American*, to be attributable to the fact that the network of wire in the glass acts as a good conductor of heat, and thereby prevents the accumulation of sufficient heat to melt the glass; and although it may thereby be softened and rendered pliable, the network of wire prevents the glass from giving way by reason of its own weight when softened by the heat.

Patent Cases.—We make the following extracts from the inaugural address delivered before the Society of Patent Agents by Mr. J. Sinclair Fairfax, A.I.N.A., A.I.E.E.:—

> The cost of fighting important patent cases through the Courts is enormous, and there is always the risk that a patent for a meritorious invention may be declared invalid. There is, further, the well-grounded fear that the judge who decides the case may not understand the technical principles which are the essence of the question, or that he is forced to decide against his own convictions of justice upon the weight of expert evidence which he is unable to check. These difficulties undoubtedly add to the precarious nature of patent property, but there is no inherent reason why it should be so. To avoid them it has often been proposed to establish a Patent Court as a special division of the High Court, with a judge appointed for his special knowledge of technical matters. . . . There are signs of a new profession in formation, composed of men of high professional and theoretical training, of great intellectual ability, and of great experience in the Courts as witnesses in patent cases. If such witnesses can be retained by either side, irrespective of the merits of a case, then sooner or later they must become advocates, and therefore expert witnesses in a double sense. Out of their wide experience the judges can check almost all other evidence taken before them, but which one is able of his own knowledge to correctly discern the material points in such advocate evidence in a patent case?

Personal.—Mr. A. H. Vesey, A.M.I.C.E., announces that he has resigned his post of consulting engineer to Messrs. Vaughan & Brown, and has entered into partnership with Mr. Herbert H. Fawckner, of the Eastern Telegraph Company. They will carry on the business of consulting engineers solely.

Mr. Henry F. Lewis asks us to state that he has retired from the position of manager to the London Electric Omnibus Company, Limited.

We understand that Mr. W. Worby Beaumont, M.Inst.C.E., who has for some years been identified with the joint editorship of the *Engineer*, resigned his editorial position some time since, in order that he might hereafter devote himself entirely to his consulting engineering practice at his offices in Outer Temple, 222, Strand.

Appointment.—Mr. David Hay, one of the resident engineers at the Blackwall Tunnel, has been appointed the engineer in charge of the City and South London Extension Railway.

Magnetic Concentration.—Amongst the methods adopted for the magnetic concentration of ores containing zinc and iron, one known as the Wetherill system appears to be attracting much attention in America. There is a long account of this in the *Engineering and Mining Journal*, 1896, Vol. 61, p. 564, from which the following is an abstract:—"Two electro-magnets are arranged with adjustable pole-pieces (fixed at any point by means of suitable nuts) at a convenient distance apart. The ore is fed in a $\frac{1}{8}$ to $\frac{3}{16}$ inch layer on to a belt from a hopper with adjustable feed. The belt travels towards and over a roller, bringing the fine ore particles within the sphere of attraction of the pole-pieces; the magnetic portion is attracted, and is caught and carried on by another and a horizontal belt travelling away from the poles. The ore particles are thus carried off until they fall by gravity into a suitable receptacle. The non-magnetic particles fall into a second receptacle beneath. A proper adjustment of the current, of the space between the poles, and of the distance of the belt carrying the ore from the poles, causes the ore to be removed by the horizontal belt as fast as it is attracted by them. With a current of 6 amperes and 16 volts, such a machine with four pole-pieces separates franklinite from willemite, but requires to be passed three times through the apparatus to insure perfect separation, each passage being made at the rate of $3\frac{1}{2}$ tons per hour. For hæmatite a yoke with two pole-pieces is used with a current of 8 amperes and 22 volts. The machine for treating coarse particles is slightly modified. The process as in use in the Lehigh Zinc and Iron Company, removes garnet, franklinite, tephroite and fowlerite from willemite, zincite and limestone, treating 1,000 tons of the mixture per mensem. The magnetic intensity of the machine being readily adjusted, several products may be obtained showing slight differences in magnetic permeability. The only substances in which iron is largely present that have not been attracted by the magnets constructed up to the present time are the higher sulphides and "the cyanides of that metal." Magnets of greater power are being constructed, and it is expected that these substances will also be capable of magnetic separation.

Lectures.—The Physical Society of Glasgow University will open the 1896-97 session to-night (Friday), at 8 p.m., with the Presidential Address, by Magnus Maclean, M.A., D.Sc., F.R.S.E., on "Röntgen Rays" (experimentally illustrated). Communications have been promised by:—J. C. Beattie, D.Sc.; J. T. Bottomley, M.A., D.Sc., F.C.S., F.R.S.; Alexander Galt, B.Sc., F.R.S.E.; Prof. George A. Gibson, M.A., F.R.S.E.; John Gray, B.Sc.; J. R. Erskine Murray, B.Sc.; M. Smoluchowski Smolin, Ph.D. (Vienna).

Mr. W. Lynd lectures at Ilfracombe, in connection with the University Extension Lectures, on November 25th, on "The Röntgen Rays," and on November 26th on "Edison and his Inventions."

The McDonald Battery.—Mr. McLachlan, who, according to the letter we received last week from Mr. Urquhart, secretary and solicitor to the McDonald Patent Battery Syndicate, is "perhaps the largest owner of electrically propelled launches in the Kingdom," came to see us on Wednesday afternoon. He disclaims altogether the proud distinction conferred upon him by Mr. Urquhart, his ownership of launches being confined to one skiff on the River Lea. We shall be glad if the secretary and solicitor to the McDonald Syndicate will justify his statement to us, which Mr. McLachlan says is made without his sanction.

Electrical Sanitation for Bombay.—The Municipality of Bombay have had under consideration for some months the adoption of the Hermite process in that town. The report of their engineer, Mr. Hewett, who was recently in England, and inspected the working of the Netley Hospital plant, was so favourable that they have now voted the funds for a considerable installation, and Messrs. Paterson and Cooper have received instructions to prepare the necessary machinery for shipment early in December.

The Institution of Electrical Engineers.—On Thursday, November 26th, the discussion will be continued on Mr. J. Gavey's paper on "The Telephone Trunk Line System in Great Britain."

Zinc Analysis by Electrolysis.—The objections have been raised against the electrolytic method of estimating zinc that :—1. The deposition of copper upon the platinum dish takes time. 2. About two hours are required for the deposition of 0·12—0·2 gramme of zinc. 3. The edges of the deposit soon oxidise or become dissolved. 4. In general, the zinc can only be separated from other metals by chemical processes. The author shows how the first three objections are overcome. The dish must be coppered to a height of about 2—3 mm. above that at which the zinc solution will stand ; thus, if 230 c.c. of zinc solution are to be used, 250 c.c. of copper solution should be taken. If the zinc solution be properly made up, there is no risk of the precipitated zinc redissolving. It should contain not less than 0·3—0·5 gramme of zinc, and is prepared for electrolysis by adding to the neutral solution 2 grammes of ammonium sulphate and 5—7 grammes of ammonium lactate, and acidifying with a few drops of lactic acid. After the current has been passing for about 25 minutes, the electrolyte must be nearly neutralised with ammonia. A saturated solution of copper sulphate, with 5 per cent. of nitric acid, may be used, or else a solution of the double oxalate of copper and ammonia in oxalic acid. When the electrolyte is stirred, and a moderately high current density is used, about 85 per cent. of the zinc is deposited in 35 minutes, and about 96 per cent. of it in an hour. The deposition of the remainder of the zinc can be accelerated by pouring the solution out into a fresh coppered dish, and finishing the electrolysis in this. If this be done from 40 to 60 minutes after the start, the whole analysis only takes about 1¼ hour. The original paper may be found in the *Zeitschrift für Elektrotechn*, 1896, ii. (30), p. 655.

The Production of Glycerine and Caustic Soda from Soap Lyes by Means of Electrolysis.—In almost every industry there are waste products which are great sources of profit leakage, and which, if they could only be utilised, would considerably reduce the prime cost. Of such a nature is the soap lye left in the manufacture of soap. A method, however, has been recently elaborated by J. Glatz and O. Lugo, which enables the glycerine and the caustic soda which soap lyes contain, to be recovered. The method is based upon electrolysis. The soap lye, which contains free alkali, sodium, or potassium hydrate, fatty glycerides, free glycerine and some fatty acids, is subjected to the action of an electric current, the anode being composed of zinc or carbon, preferably of the latter, retained in contact with the liquor under treatment, whilst the cathode is separated from the anode by a porous partition. The current decomposes the caustic soda in the lye, the liberated sodium being attracted to the cathode and immediately oxidised to sodium hydrate. The glycerine compounds are decomposed and the glycerine set free, whilst the albuminoid and colouring matters are rendered insoluble, and are readily removed by filtration. The colour of the lye is changed from a dark brown to a light straw colour. After the electrolytic treatment the insoluble matter is separated from the liquor, and the latter distilled. The glycerine obtained is perfectly pure and free from discoloration, and can be used for all purposes in the arts. The caustic soda produced is practically pure, and can be used at once by the soap-maker, since, by the above process, it is possible to produce a solution of the required density.

Society of Arts.—On Monday, November 23rd, at 8 p.m., Prof. Vivian B. Lewes will commence his Cantor Lectures on "The Use of Gas for Domestic Purposes." On November 25th, at 8 p.m., Mr. W. Worby Beaumont will lecture on "Recent Developments in Mechanical Road Carriages."

Dismissed.—A claim against Messrs. C. J. Grist & Co., electrical contractors, Norwich, by S. E. Moreton, electrician, for £9, a month's wages, for wrongful dismissal, was dismissed by Judge Addison, Q.C., at the Norwich County Court on 17th inst.

The Uses of Electric Lighting.—A Windermere paper commenting upon the introduction of electric light into certain roads there, says the light is now a boon to "benighted wayfarers."

Correction.—In our article last week on "New Reducing Gear," for 30 H.P. in reference to Fig. 3, read 3 H.P.

NEW COMPANIES REGISTERED.

Armstrong-Dove Motor Syndicate, Limited (49,965).—Registered November 2nd, with capital £6,000 in £10 shares, to enter into an agreement with T. Armstrong and L. Dove, and to carry on the business of motor manufacturers, electricians, cycle manufacturers, carriage builders, engineers, machinists, fitters, founders, wire drawers, tube makers, &c. The subscribers (with one share each) are:—R. H. Goody, 34, Mersea Road, Colchester, gentleman; D. W. Sharples, 54, Hemberton Road, Clapham, gentleman; F. S. Kinchent, Prince of Wales Road, Carshalton, gentleman; R. J. L. Kinchent, 34, Hemberton Road, Stockwell, gentleman; W. Davison, 1, Queen's Don Road, Highgate Road, Clapton; D. W. Drummond, 23, Grove Terrace, Highgate Road, N.W.; T. B. Miller, 16, Foxbourne Road, Upper Tooting. Table "A" mainly applies. Registered by Farlow & Fuller, 1, Church Court, Clement Lane, E.C.

British and Colonial Cycle and Components Syndicate, Limited (50,059).—Registered November 10th; capital, £10,000 in £1 shares, to adopt an agreement with D. T. Davies, and to carry on the business of cycle and motor manufacturers, mechanical and electrical engineers, machinists, fitters, founders, millwrights, rubber manufacturers, and merchants. The subscribers (with one share each) are:—G. P. Locker, Woodend Road, Erdington, secretary; A. Newey, Handsworth, clerk; T. Davies, 6, Sefton Road, Edgbaston, cashier; S. E. Harris, 44, Braithwaite Road, Birmingham, student; W. J. Thomas, Drayton Road, King's Heath, Birmingham; H. Hackett, 71, Temple Row, Birmingham, chartered accountant; G. Hackett, Acocks Green, Birmingham, clerk. The number of directors not to be less than three nor more than seven; qualification, 500 shares; remuneration as the company may decide. Registered office, 53, New Street, Birmingham.

Electrical Cab Company, Limited (50,104).—Registered November 12th, capital £150,000 in £1 shares, to adopt an agreement with the Traffic Syndicate, Limited, and to carry on the business of cab and carriage proprietors, and builders, job masters, carriers, carpenters, joiners, electricians, mechanical engineers, machinists, rubber manufacturers, &c. The subscribers (with one share each) are:—E. T. Botwright, 115, Osborne Road, Forest Gate, S.E., gentleman; J. W. Honess, 22, Caistor Road, Balham, gentleman; W. Mitchell, 20, Reginald Road, Forest Gate, gentleman; E. T. Church, 41, Copleston Road, Denmark Park, clerk; P. J. Newton, 29, Evelyn Road, Richmond, clerk; W. J. Yeoman, 23, Muschamp Road, East Dulwich, secretary; W. H. May, 38, Cornwall Road, Brixton, clerk The number of directors not to be less than three nor more than seven; the subscribers to appoint the first; qualification £500; remuneration £200 each per annum and £250 for the chairman. Registered by Ashurst & Co., 17, Throgmorton Avenue, E.C.

Max-Saturn Electrical Syndicate, Limited (50,111).—Registered November 11th with a capital of £3,000 in £1 shares, to carry on the business of an electric power and light company in all its branches, and to carry on the business of electricians, mechanical engineers, suppliers of electricity and electrical apparatus. The subscribers (with one share each) are:—E. M. Winter, 30, Arthur Road, Finsbury Park, N., accountant; W. T. Carter, 9, Brandon Street, Gravesend, engineer; W. S. Mackenzie, Constantine Road, Hampstead, cashier; C. Brokenbro, 130, Powerscroft Road, Clapton, clerk; S. E. Hubbard, 20, Ely Place, E.C., solicitor; E. F. B. Harston, 4, Bishopsgate Street, E.C., solicitor; A. J. Place, 202, High Street, Borough, S.E., clerk. The number of directors is to be two; the subscribers are to appoint the first; qualification, £100; remuneration £2 2s. each per board meeting attended, when 15 per cent. per annum is paid. Registered office, 20, Ely Place, E.C.

High Wycombe Electricity Supply Company, Limited (50,116).—Registered November 13th with a capital of £10,000, in £1 shares, to carry on in the Borough of High Wycombe, Bucks, the business of an electric lighting and power company in all its branches, and to enter into an agreement with the Mayor, aldermen, and burgesses of the said borough to take over and exercise the lighting powers conferred by the Electric Lighting Orders Confirmation (No. 1) Act, 1894. The subscribers (with one share each) are:—G. E. B. Pritchett, 31, Soho Square, W.C., electrical engineer; T. W. Pritchett, 31, Soho Square, W.C., electrical engineer; A. G. Gold, 31, Soho Square, W.C., electrical engineer; J. F. Findlay, 20, Billiter Street, E.C., gentleman; Walter B. Hopkins, 30, Parliament Street, S.W., civil engineer; A. B. Bryden, 31, Soho Square, W.C., accountant; A. W. Cox, 31, Soho Square, W.C., clerk. The number of directors is not to be less than two, nor more than seven; the subscribers are to appoint the first; qualification, 100 shares. Registered by Jordan & Sons, Limited, 120, Chancery Lane, W.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Cottonwood Water-Power and Electric Company, Limited (47,196).—This company's annual return has just been filed. The capital is £210,000 in £1 shares (of which 105,000 are preference); 35,627 preference and 36,708 ordinary have been taken up, and 35,000 of each are considered as paid; 15s. per share has been called on the rest, and £1,896 has been received, leaving 5s. in arrears.

Western Counties Electric Light and Power Syndicate, Limited (36,294).—This company's annual return has just been filed. The capital is £25,000 in £50 shares, of which 120 are deferred; 85 ordinary have been taken up, the full amount called, and £4,250 paid. The 120 deferred have all been issued as paid.

Connolly Bros., Limited.—This company's annual return was filed on October 21st; 1,805 shares have been taken up out of a capital of £20,000 in £5 shares, and 1,798 are considered as paid; £5 per share has been called and paid on the remaining seven shares.

Column Printing Telegraph Syndicate Limited (29,493).—This company's annual return was filed on August 27th. The capital is £25,000 in £50 shares, and 289 of these have been taken up; 100 have been issued as fully paid, and £50 per share has been called on the rest. £8,940 has been received, and £510 remains unpaid.

Aluminium Company, Limited (24,612).—This company's annual return was filed on August 21st. The whole capital of £80,000, in £1 shares (of which 60,000 are "A," and the rest "B") has been taken up, and the "B" shares are considered as paid. £60,000 has been called and paid on the others.

Halifax and Bermudas Cable Company, Limited (28,972).—This company's annual return was filed on October 3rd. The capital of £50,000 in £5 shares has been taken up, and considered as paid.

Aurora Electric Lighting and Distribution Company, Limited (34,109).—This company's annual return was filed on October 19th. The capital is £25,000, in £1 shares, and 5,935 shares have been taken up. Of these 5,000 are considered as fully paid, and £935 has been paid on the rest.

Automatic Electric Railway Signal Company, Limited (37,636).—This company's annual return was filed on October 16th. 5,940 shares have been taken up out of a capital of £10,000, in £1 shares, and 4,300 of these have been issued as paid. The full amount has been called on the rest, resulting in the receipt of £1,647 10s., including £7 10s. paid in connection with the forfeiture of 15 shares.

General Electric Tramways Company, Limited (43,428).—This company's annual return was filed on October 9th. 13,000 shares have been taken up out of a capital of £50,000 in £1 shares, and the full amount has been called and paid.

G. E. Belliss & Co., Limited (39,411).—This company's annual return has just been filed. The capital is £150,000 in £10 shares (of which 5,000 are preference); 4,100 preference and 6,270 ordinary have been taken up, and 4,098 of the former are considered as paid; £10 per share has been called on two preference and £5 per share on the ordinary, and £31,370 has been paid.

CITY NOTES.

West India and Panama Telegraph Company, Limited.

The ordinary general meeting was held on Wednesday at Winchester House.

Mr. C. W. Earle, who presided, reminded the shareholders that the past half-year—to June 30th—was their better half, it being the period in which the sugar crop in the West Indies was ready for shipment, and therefore they must always expect the second half of the year to be less favourable in the way of traffic. For the past half-year they were able to divide the largest dividend ever paid by them. For the 25 years of their existence the company had never before paid as much as 1s. 6d. per share on the ordinary shares, and this was so far satisfactory, although, compared with what they ought to be earning, it was very much the reverse. The receipts for the past half-year had exceeded those of the corresponding period of 1895 by £2,468, and there was an increase of £332 in the expenses. The small increase referred to in the expenses had entirely arisen in connection with the reserve for the depreciation of ships. They had thought that, considering the age of their vessels, they were not making sufficient provision for depreciation, and they had therefore written £1,000 off this account. Their traffic during the half-year had no doubt been increased by certain exceptional circumstances, the Colonial Office having been obliged to send messages to, and to receive replies from British Guiana in connection with the Venezuelan question. To this circumstance they must attribute in a great measure the slight improvement in their accounts. At their last meeting he called their attention to the question of the proposed Bermuda-Jamaica extension, which Mr. Chamberlain, in reply to a question in the House of Commons, had stated that the Government were negotiating for. It seemed that the Government were still anxious to make this connection, but the difficulty was to serve the small traffic of the West Indies. Many of this company's stations, for instance, scarcely ever sent a message, but, owing to the Acts which were originally passed and to the obligations imposed them, they were obliged to keep these stations open. His attention had been particularly called to this point in the last letter they received from their general superintendent, who mentioned as a curious fact that in one of the colonies the amount derived in the half-month—14 days—from received and transmitted messages was only £5. The fact was that almost the whole use of the company was in connection with Government service—to knit together the colonies and to protect them from rebellion, such as they had before the telegraph existed in Jamaica. He regretted to say that there was very little commercial interest. For the past five years the company's receipts from traffic had averaged £57,000 a year, whereas the estimate given in the original prospectus—with which the present board had nothing to do—was £156,000 a year. They would therefore understand the reason of the company's unfortunate position. The question of the Bermuda-Jamaica cable constantly gave them considerable anxiety. In these matters there was always the danger of people coming forward with a low contract to perform the work. The promoter would take it in conjunction with a cable manufacturer, and it would be blazoned forth in the prospectus that the line was subsidised by her Majesty's Government. Some people then thought that the prospect of 4 per cent. which was held out was equal to Consols, but the Treasury took the lowest offer that was made, and there was no guarantee whatever for the permanence of the undertaking. He viewed with considerable alarm a new principle which had arisen in this country—the proposals of Government to subsidise, at the expense of the tax-payers, competition with enterprises such as theirs. This Empire had been built up by the enterprise of individuals, and probably by the same means it would be continued; but whenever an enterprise was now of use to the public and profitable to its proprietors—he did not mean that their company was profitable—an outcry was raised to enter into competition with it at the public expense. He thought it very damaging to future enterprise in this country that such a state of things should exist. He concluded by moving the adoption of the report and the payment of the dividends recommended.

Mr. William Andrews seconded the motion, which was carried unanimously.

The Edison & Swan United Electric Light Company, Limited.

An extraordinary general meeting of this company will be held at the Cannon Street Hotel on Tuesday, November 24th, 1896, at 12 o'clock noon, for the purpose of considering, and if thought fit, passing with or without modification the subjoined resolutions, or resolutions to the like effect.

Resolutions.

"1. That it is expedient to acquire and take over by way of amalgamation the undertaking of the Manchester Edison-Swan Company, Limited.

"2. That the draft agreement for the purpose expressed to be made between the Manchester Edison-Swan Company, Limited, of the one part, and this company of the other part, be, and the same is hereby approved, and that the directors be and they are hereby authorised to execute an agreement in the terms of the said draft, and to carry the same into effect, with full power to assent to any modifications therein which they think expedient in the interests of this company, either before or after the execution thereof.

"3. That the directors be and they are hereby authorised, upon the adoption of the said agreement by the liquidator of the Manchester Edison-Swan Company, Limited, with the sanction of a special resolution of the said Company, to appoint Mr. W. P. James Fawcus, one of the directors of the said company, to be a director of this company.

"4. That for the purpose of redeeming the existing 4½ per cent. debenture stock, and providing for the extension of the business, the directors be and they are hereby authorised to create and issue perpetual debenture stock of the nominal amount of £350,000, carrying interest at the rate of 4 per cent. per annum, and redeemable at the option of the company at 110, and to be constituted and secured by trust deed in such form and manner as the directors think expedient.

"5. That the directors be and they are hereby authorised to issue any of the said new debenture stock at such times and upon such conditions as they may think fit, in exchange for any of the existing debenture stock, or otherwise as they may approve."

British Electric Traction Company, Limited.—Letters of allotment in the British Electric Traction Company have been posted. We understand the public did not respond very freely, but the Electric and General Investment Company and their financial friends have provided the necessary capital.

Eastern and South African Telegraph Company, Limited.—The numbers are published of 5 per cent. mortgage debentures amounting to £39,900 drawn on Monday for payment at par on January 1st at the banking house of Messrs. Barclay & Co., Lombard Street, E.C., when the interest thereon will cease.

Willans and Robinson, Limited.—The registers of debenture stockholders and of transfers will be closed prior to the payment of interest, until November 29th.

TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending November 15th, 1896, were £1,078; week ending November 17th, 1895, £958; increase, £120; total receipts for half-year, 1896, £18,825; corresponding period, 1895, £17,616; increase, £1,209.

The Liverpool Overhead Railway Company. The receipts for the week ending November 15th, 1896, amounted to £1,143; corresponding week last year, £1,028; increase, £115.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending November 13th, 1896, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £2,688.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1893.	1894.	1895.	Closing Quotation, Nov. 11th.	Closing Quotation, Nov. 18th.	Business done during week ended Nov. 18th, 1896. Highest.	Lowest.
173,400£	African Direct Teleg., Ltd., 4 % Deb.	100	4 %	4 %	4 %	100 –104	100 –104	...	...
25,000	Amazon Telegraph, Limited, shares...	10	...	...	...	8½ – 9½	8½ – 9½	...	...
1,012,880£	Anglo-American Teleg., Ltd.	Stock	£2 11s.	£2 2s.	£2 9s.	52 – 55	51 – 54	53½	51
2,993,560£	Do. do. 6 % Pref.	Stock	£5 2s.	£4 4s.	£4 18s.	96½ – 97½	96 – 97	97½	96
2,993,560£	Do. do. Defd.	Stock	...	...	...	10⅝ – 11¼	10 – 10½	10 5/16	10 5/16
130,000	Brazilian Submarine Teleg., Ltd.	10	6½% §	7 %	7 %	14¾ – 15½	14¾ – 15½	15⅛	14¾
75,000£	Do. do. 5 %, Debs., 2nd series, 1906	100	5 %	5 %	5 %	113 –117	113 –117	...	...
44,000	Chili Telep., Ltd., Nos. 1 to 44,000	5	... §	2½%	4 %	3¼ – 3⅜	3¼ – 3⅜	...	...
10,000,000$	Commercial Cable Co.	$100	7 %	7 %	7 %	157 –162	157 –162	161	...
224,850	Con ol dated Telep. Const. and Main., Ltd. ...	10/-	2 % §	1½%	1½%	1 1/16 – 1 3/16	1 1/16 – 1 3/16	...	...
16,000	Cuba Teleg., Ltd.	10	8 %	8 %	8 %	11½ – 12½	11½ – 12½	12	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	18½ – 19½	18½ – 19½	...	...
12,931	Direct Spanish Teleg., Ltd.	5	4 %	4 %	4 %	3½ – 4½	3½ – 4½	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	10 %	10 – 10½	10 – 10½	..	...
30,000£	Do. do. 4½ % Debs. Nos. 1 to 6,000 ...	50	...	4½%	4½%	107 –110%	107 –110 %	...	...
60,710	Direct United States Cable, Ltd.	20	2½% §	2 %	2½%	9¼ – 9⅜	9¼ – 9⅜	9 7/16	...
400,000	Eastern Teleg., Ltd., Nos. 1 to 400,000	10	6½% §	6½%	6½%	17¼ – 17⅜	17¼ – 17⅜	17⅜	17¼
70,000	Do. 6 % Cum. Pref.	10	6 % §	6 %	6	18½ – 19½	17½ – 18½	...	...
102,100£	Do. 5 % Debs., repay. August, 1899	100	5 %	5 %	5 %	105 –108	105 –108	...	...
1,297,837£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	4 %	126 –129	126 –129	...	...
250,000	Eastern Extension, Australasia and China Teleg., Ltd. ...	10	7 %	7 %	7 %	17¼ – 17⅜	17¼ – 17⅜	17 1/16	17⅜
54,100£	Do. 5 % (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	100	5 %	5 %	5 %	100 –104	100 – 104	103½	...
194,300£	Do. do. Bearer, 1,050—3,975 and 4,327—6,400	100	5 %	5 %	5 %	101 –104	101 –104	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	129 –132	129 –132	131	...
80,600£	Eastern and South African Teleg., Ltd., 5 % Mort. Deb. 1900 redeem. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	5 %	5 %	101 –105	101 –105	...	...
107,600£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	5 %	5 %	102 –105	102 –105	...	...
300,000£	Do. 4 % Mort. Debs. Nos. 1 to 3,000, red. 1909	100	4 %	4 %	4 %	106 –109	106 –109	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	108 –111 %	108 –111 %	...	...
180,227	Globe Telegraph and Trust, Ltd.	10	4½% §	4½%	4½%	11 – 11½	11 – 11½	11 7/16	11
180,042	Do. do. 6 % Pref.	10	6 % §	6 %	6 %	17¼ – 17⅜	17¼ – 17⅜	17⅜	17¼
150,000	Great Northern Teleg. Company of Copenhagen	10	8⅝%	8⅝%	10 %	24 – 25	24 – 25	24½	...
180,000£	Do. do. do. 5 % Debs.	100	5 %	5 %	5 %	104 –107	104 –107	...	...
17,000	Indo-European Teleg., Ltd.	25	10 %	10 %	10 %	53 – 56	53 – 55	...	...
100,000£	London Platino-Brazilian Teleg., Ltd. 6 % Debs.	100	6 %	6 %	6 %	109 –112	109 –112	...	...
28,000	Montevideo Telephone 6% Pref., Nos. 1 to 28,000... ...	5	4 %	4 %	4 %	2 – 2½	2 – 2½	...	...
484,597	National Teleph., Ltd., 1 to 484,597	5	5 % §	5 %	5½%	7⅛ – 7⅜	7⅛ – 7⅜	7⅜	7 3/16
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	17 – 19	17 – 19	18¼	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	17 – 19	17 – 19	...	...
119,234	Do. 5 % Non-cum. 3rd Pref., 1 to 119,234	5	5 %	5 %	5 %	6⅜ – 7	6⅜ – 6⅞	6 13/16	6⅜
1,100,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	105 –108	105 –108	106½	...
171,504	Oriental Teleph. & Elec., Ltd., Nos. 1 to 171,504, fully paid	1	...	4½%	5 %	1 1/16 – 1 3/16	1 1/16 – 1 3/16	1 1/16	...
100,000£	Pacific and European Tel., Ltd., 4 % Guar. Debs, 1 to 1,000	100	4 %	4 %	4 %	108 – 111	108 – 111	109¼	...
11,839	Reuter's Ltd.	8	0 %	nil	5 %	7 – 8	7 – 8	...	...
3,381	Submarine Cables Trust	Cert.	...	..	...	138 –143	138 –143	139	138½
58,000	United River Plate Teleph., Ltd.	5	...	3 %	4 %	3¼ – 3⅜	3¼ – 3⅜	3 7/16	3⅜
146,732£	Do. do. 5 % Debs.	Stock	5 %	5 %	5 %	101 –106	101 –106	103½	...
15,509	West African Teleg., Ltd., 7,501 to 23,109	10	nil	nil	4 %	5 – 6	5 – 6	...	...
238,360£	Do. do. do. 5 % Debs.	100	5 %	5 %	5 %	103 –106	103 106	105	103
36,000	West Coast of America Teleg., Ltd.	10	nil	nil	nil	½ – 1½	½ – 1½	...	...
158,380£	Do. do. do. 8 % Debs., repay. 1902	100	8 %	8 %	8 %	97 –102	95 – 101	99	...
64,248	Western and Brazilian Teleg., Ltd.	15	2½%	3 %	3 %	7⅜ – 8¼	7⅜ – 8¼	7⅜	...
33,129	Do. do. do. 5 % Pref. Ord. ...	7½	5 %	5 %	5 %	6½ – 7	6½ – 7	...	...
33,129	Do. do. do. Def. Ord.	7½	...	1 %	1 %	1⅜ – 2¼	1⅜ – 2¼	...	...
165,200£	Do. do. do. 6 % Debs. "A," 1880 Red.	100	6 %	6 %	6 %	103 –107	103 –107	...	...
206,400£	Do. do. do. do "B," do.	100	6 %	6 %	6 %	103 –107	103 –107	...	...
88,321	West India and Panama Teleg., Ltd.	10	⅞%	⅞%	⅞%	1½ – 1⅝	1⅝ 1⅝	1 9/16	1 7/16
84,563	Do. do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	11⅜ 12¼	11⅜ 12¼	11¼	11 1/16
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	9½ – 10½	9½ 10½	10⅜	10½
80,000£	Do. do. 5 % Debs. No. 1 to 1,800 ...	100	5 %	5 %	5 %	108 –111	108 –111	...	...
1,777,000$	Western Union of U. S. Teleg., 7 % 1st Mort. Bonds ...	$1000	7 %	7 %	7 %	107 –112	107 –112	...	...
164,300£	Do. do. 6 % Ster. Bonds.	100	6 %	6 %	6 %	100 –105	100 105	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electy. Supply	5	4½%	4½%	5 %	9½ – 10	9½ 10	...	...
10,277	*Chelsea Electricity Supply, Ltd., Ord., Nos. 1 to 10,277 ...	5	5 %	5 %	5 %	7⅜ – 8¼	7⅜ – 8¼	...	...
60,000	Do. do. do. 4½ % Deb. Stock Red. ...	Stock	...	...	4½%	114 –117	114 –117	...	...
40,000	City of London Elec. Lighting Co., Ltd., Ord. 40,001—80,000	10	...	5 %	5 %	16 – 17	16 – 17	16½	..
40,000	Do. do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	17 – 18	16½ – 17½	17 5/16	17
300,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	5 %	130 –135	130 –135	133½	...
22,475	County of Lond. & Brush Prov. E. Ltg. Ltd., Ord. 1—22,475	10	...	...	nil	8½ – 9½	8 – 9	8⅝	...
20,000	Do. do. do. 6% Pref., 40,001—50,000 ...	10	...	...	6 %	13⅜ – 14¼	13⅜ – 14¼	13⅞	...
10,000	Do. do. do. iss. at 2 pm., all paid	10	...	...	...	7½ – 8½	7½ – 8½	...	...
49,900	*Metropolitan Electric Supply, Ltd., 101 to 50,000 ...	10	2½%	3 %	4 %	13 – 14	13 – 14xd	13⅜	13
12,500	Do. Ord., 50,001—62,500, iss. at £2 prem., £1 paid	10	...	...	...	6½ – 7	6½ – 7	...	...
150,000£	Do. 4½% first mortgage debenture stock	...	4½%	4½%	4½%	121 –124	121 –124	...	...
6,452	Notting Hill Electric Lightg. Co., Ltd.	10	...	1 %	2 %	10½ – 11½	9½ – 10½	10½	9⅞
19,980	*St. James's & Pall Mall Elec. Light Co., Ltd., Ord., 101-20,080	5	4½%	6½%	7½%	12 – 13	12 – 13	12⅝	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	10 – 11	10 – 11	...	...
50,000	Do. do. 4 % Deb. stock Red. ...	Stock	...	...	...	106 –109	106 –109	...	...
67,900	*Westminster Electric Supply Corp., Ord., 101 to 68,000	5	4 %	5 %	7 %	10½ – 11½	10½ - 11½	11	10⅝

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid. ‖ Dividends paid in deferred share warran profits being used as capital.

§ Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL, COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1893.	1894.	1895.	Closing Quotation Nov. 11th.	Closing Quotation, Nov. 18th.	Business done during week ended Nov. 18th, 1896. Highest.	Lowest
£0,000	Brush Elecl. Enging. Co., Ord., 1 to 90,000...	£	5 % §	2½%	...	⅞— 1⅛	⅞— 1⅛	⅞	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	£	6 % §	3 %	...	1 — 1¼	1 — 1¼	1 1/16	...
125,000	Do. do. 4½ % Perp. Deb. Stock.... ...	Stock	4½%	4½%	...	110 —113	110 —113	...	...
76,770	Do. do. 4½% 2nd Deb. Stock Red. ...	Stock	...	...	...	96 —100	96 — 100	96½	...
9,104	Central London Railway, Ord. Shares	10	...	...	...	10 — 10½	10 — 10½	...	...
207,649	Do. do. do. £4 paid	10	...	...	...	4 — 4¼	4 — 4¼	4⅛	4
630,000	City and South London Railway	Stock	1⅛%	1⅛%	1 1/16%	50 — 52	52 — 54	54	52
28,180	Crompton & Co., Ltd., 7 % Cum. Pref. Shares, 1 to 28,180	£	3 % §	*nil*	*nil*	2 — 2½	2 — 2½	...	...
89,261	Edison & Swan United Elec. Lgt., Ltd., "A" shrs, £3 pd. 1 to 89,261	£	7 %	5 %	5 %	1⅞— 2¼	1⅞— 2¼	1⅞	...
17,139	Do. do. do. "A" Shares 01—017,139	£	7 %	5 %	5 %	3 — 4	3 — 4	...	...
100,000	Do. do. do. 4½% Deb. Stock Red. ...	Stock	...	4½%	4½%	103 —106	103 —106	103	...
110,000	Electric Construction, Ltd., 1 to 110,000	£	*nil*	*nil*	5 %	1½— 1⅝	1½— 1⅝	...	...
12,845	Do. do. 7 % Cum. Pref., 1 to 12,845 ...	£	7 %	7 %	7 %	2½— 3	2½— 3	...	...
91,195	Elmore's Patent Cop. Deposg., Ltd., 1 to 70,000	£	*nil*	*nil*	...	⅜— ⅝	⅜— ⅝	...	...
69,385	Elmore's Wire Mfg., Ltd., 1 to 69,385, issued at 1 pm. ...	£	*nil*	*nil*	...	¼— ½	¼— ½	...	...
9,600	Greenwood & Batley, Ltd., 7 % Cum. Pref., 1 to 9,600 ...	£	*nil*	*nil*	10½%	10½— 11½	10½— 11½	...	...
10,000	Henley's (W. T.) Telegraph Works, Ltd., Ord.	£	5 %	6 %	8 %	17 — 18	17 — 18	...	...
3,000	Do. do. do. 7% Pref.	£	7 %	7 %	7 %	18½ — 19½	18½ — 19½	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock	Stock	...	...	4½%	109 —114	109 —114	113½	...
50,000	India-Rubber, Gutta Percha and Teleg. Works, Ltd. ...	£	12½%	10 %	10 %	21 — 22	20½— 21½	21½	20⅞
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	105 —108xd	105 —108	...	...
37,500	†Liverpool Overhead Railway, Ord.	£	1 %	1½%	2⅜%	13⅜— 13½	13⅜— 13½	...	...
10,000	† Do. do. Pref., £10 paid	£	5 %	5 %	5 %	16⅞— 17⅜	16⅞— 17⅜	...	...
37,350	Telegraph Constn. and Maintce., Ltd.	£	20 %	20 %	15 %	39 — 42	39 — 42	41½	40½
150,000	Do. do. do. 5 % Bonds, red. 1899	100	5 %	5 %	5 %	104 —107	104 —107	...	...
54,000	Waterloo and City Railway, Nos. 1 to 54,000, £6 paid ...	£	...	...	...	7⅜— 8½	7⅜— 8½	8½	...

Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ Last dividend paid was 50 % for 1890.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.
Crompton & Co.—The dividends paid on the ordinary shares (which have not a Stock Exchange quotation), are as follows: 1892—0%; 1891—7%; 1890—8%.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

* Birmingham Electric Supply Company, Ordinary of £5 (£4 paid), 8, £5 (fully paid) 9½.
Electric Construction Corporation, 6 % Debentures, 104—107.
House-to-House Company (£5 paid), 4½—4⅝.
Do. do. 7 % Preference, of £5, 8½—9.
Do. do. 4½% Debentures of £100 109—111.
Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid) 10—10½; 1st Preference Cumulative 6 %, £5 (fully paid), 8—8½.
London Electric Supply Corporation, £5 Ordinary, 1—1½.
Yorkshire House-to-House Electricity Company, £5 Ordinary Shares fully paid, 7½—8.

* From Birmingham Share List.

Bank rate of discount, 4 per cent. (October 22nd, 1896).

RÖNTGEN RAY APPARATUS.

THE pear-shaped Crookes tube which was originally employed for producing esographs, or pictures of the internal structure of bodies, has been gradually superseded by the Jackson focus tube, which gives more sharply defined pictures and is much more rapid in its action on the photographic plate. The cathode rays can evidently be brought to a smaller focus upon the platinum deflector of the focus tube than upon the glass wall of the Crookes tube, without risk of injury; and the Röntgen rays emitted from the face of the platinum are evidently much more intense than those given off from the back of the glass wall.

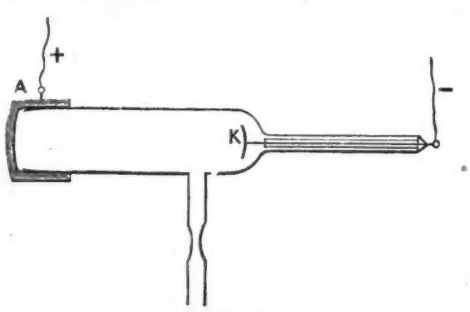


FIG. 1.

Tubes without platinum deflectors are still preferable for many physical experiments where an extremely small focus is not essential; and the intensity of the rays emitted by such tubes can be increased by replacing the glass wall of the tube by an aluminium plate. Tubes of this kind have been made by Roiti, Righi, and others, and are said to be extremely rapid in their action.

Roiti's tube, fig. 1, consists of a glass tube which is open at one end, and is drawn down at the other end to receive the conductor leading to the cathode, K. The open end of the tube is covered by an aluminium cap, A, which is ground on to the slightly conical end of the glass tube. An air-tight joint is thus formed between the aluminium cap and the glass tube, and the cap is held on by the pressure of the atmosphere when the tube is exhausted. The positive terminal of the battery is connected to the cap, which thus acts both as anode and anti-cathode. The length of the ground part of the tube is about 1·5 cm.; and no lubricant must be used in making the joint between the cap and the tube, because such lubricant is liable to evaporate and destroy the vacuum. When the tube was excited by a coil giving a shunt spark of 20 cm. in air, the inventor obtained good photographs of the bones of his hand in 30 seconds.

The size and dimensions of a tube appear to exercise an important influence upon the intensity of the Röntgen rays emitted by it. The intensity of the cathode rays produced in a tube does not, as has been generally supposed, depend on the vacuum only; the vacuum which produces the most intense Röntgen rays is not the same in all tubes. The real determining factor appears to be the intensity of the electric force acting on the tube. Chappius showed that with an ordinary pear-shaped tube the maximum effect occurred when the vacuum was 0·001 mm. Chaband and Hurmuzescu * give results for a cylindrical tube having a maximum at about 0·01 mm., and have shown that by merely changing the form of the tube, the vacuum giving the maximum effect can be changed within certain limits. According to these investigators, in tubes which are long and thin, but not small in other dimensions, the pressure of the air corresponding to the maximum intensity of the Röntgen rays is comparatively high; in other words, they consider that it is a question of the form rather than the dimensions of the tubes.

According to Righi,† it is not the elongated form, but the

* *L'Ind. Elec.*, May 25th.
† *Rend. d. R. Acc. dei. Lincei*, 5th ser., t. V., p. 47.

small dimensions of the tube which enables us to obtain the maximum intensity of the rays with a higher air pressure in the tube. He has observed that if the length of the tube (*i.e.*, the distance between the cathode and the anti-cathode) is increased, the pressure corresponding to the maximun intensity of the rays decreases, and *vice versâ*. In measuring the intensity of the X rays from small tubes which he has constructed, Righi has observed that:—1. For very high pressures there is no effect. 2. The X rays appear at a certain pressure, and their intensity increases as the pressure decreases. 3. By and bye, this intensity reaches a maximum, and then slowly decreases as the rarefaction proceeds. As the result of numerous experiments, Righi has found that the best results are obtained from tubes in which the length is equal to 10 times the interior diameter.

Righi has designed a tube in accordance with the above principles, which can be very easily and rapidly constructed. In fact, a tube of this kind can be constructed in a few minutes, and then it can be evacuated in less than a quarter of an hour by a small mercury pump.

To construct one of these tubes (shown half size in fig. 2), a piece of glass tube is taken 15 cm. in length, with an internal diameter of 8 mm. and an external diameter of 16 mm.

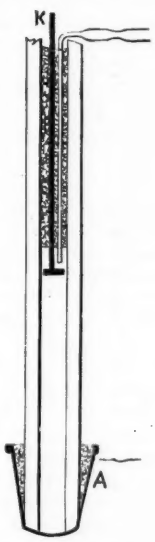


Fig. 2.

One end of the tube is introduced into an aluminium thimble, A, of sufficient size to allow the end of the tube to go right to the bottom. One of the aluminium thimbles of commerce answers admirably for this purpose. The annular space between the sides of the thimble and the glass tube is filled up with a little Spanish wax, care being taken that it does not quite reach the bottom of the thimble.

At the other, still open, end of the tube, the cathode and a small glass tube, to establish communication with the pump, are introduced, and all the interspaces are filled up with wax. The cathode is merely a small disc of aluminium, 1 to 2 mm. thick and 7 mm. in diameter, placed about 8 cm. above the bottom of the tube and fixed to a small wire, K, of the same metal, which is prolonged to the exterior of the tube.

When such a tube as this is working, it is necessary to keep the thimble immersed in water, to prevent the melting of the wax at the joint. If the tube is worked in a vertical position, the cooling water may be placed in a small tank with a thin aluminium bottom. The thimble is connected to one terminal of the coil, so as to act both as anode and anti-cathode.

In this tube, the pressure corresponding to the maximum intensity of the X rays was found to be $\frac{1}{20}$th of a millimetre. The images obtained with these tubes are very sharp, and require but a short exposure. A distinct image of the bones of the hand was obtained by Righi by a single discharge of his coil, with the photographic plate 10 cm. distant from the tube. To regulate the vacuum, it is necessary to keep these tubes connected to the pump when in action.

Previous to Righi's investigations, Colordeau* had constructed a miniature focus tube, with which he obtained remarkably good results. This tube is shown full size in fig. 3. The length of the tube is 7 mm., the diameter of the cylindrical part of the tube 6 to 7 mm., and the radius of curvature of the cathode 5 mm. Facing the anti-cathode the side of the tube is blown out into a hemispherical form till the thickness of the glass is reduced to 0·1 mm. This tube gave images of unexcelled sharpness, and images of the skeleton of the hand were produced in about 1 second, or practically instantaneously.

Davies† has constructed a tube in which the bulb is entirely of metal, and which emits Röntgen rays of remarkable penetrating power. One hemisphere of the bulb, fig. 4, is made of aluminium, and the other of copper. The aluminium hemisphere acts as the cathode, and

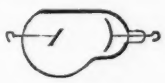


Fig. 3.

projects cathode rays towards the centre of the bulb, where they impinge on a small platinum disc which projects Röntgen rays backward through the aluminium hemisphere into the outer air. The platinum disc is supported on a wire which passes air-tight through the centre of an ebonite rod to the outside, and forms the anode terminal of the tube. After trying various forms for the anti-cathode, Davies found that the best results were obtained from that shown in fig. 4, in which a copper disc of slightly larger diameter is fixed a short distance behind the platinum disc.

The rays emitted from this tube were able to produce a visible effect on a phosphorescent screen at a distance of 62 feet in air, and through 3 feet thickness of timber. It was found that in this experimental tube a gas was given off, probably by the ebonite, which very soon destroyed the vacuum, and Davies has designed, but, apparently, not yet constructed, an improved form with the view of overcoming this and other defects.

It has been a pretty general experience with those who have worked with X ray tubes that the very highest intensity of the rays can be obtained only by using comparatively strong currents. The single platinum wire to which the cathode disc is usually connected is not capable of carrying a very large current without dangerous heating. Bottomley has constructed tubes in which several strands of wire are fused into the end of the tube bearing the cathode, and in this way has successfully overcome the difficulty.

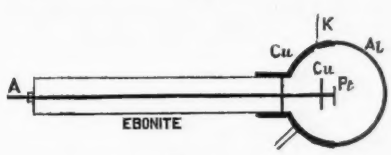


Fig. 4.

Elihu Thomson has recently designed a very handy stand for taking stereoscopic pictures with the focus tube.‡ The arrangement is illustrated in fig. 5, and he describes it as follows:—"The arrangement consists of a wooden base board, B, supporting a thin wooden platform, P, upon which the object of which a shadow picture is to be made is rested. Under the platform, P, is a space, H, for a plate-holder containing a sensitive plate. The upright pillars, S, S, serve to support a cross piece, T, to which is clamped by a clamp, C, the tubular extension from the ray tube or Crookes tube, R. The pillars, S, S, have pins which pass through openings in the cross piece, T, there being two sets of openings which permit the cross piece, T, to be given two positions relatively to the object on the platform, P. By simply lifting T off the pins and inserting the pins in the two other openings in T this shifting is made. Assume, then, that an elbow joint rests on the platform, P, and the plate-holder has been in-

* *L'Eclairage Elec.*, June 27th.
† *Nature*, July 23rd, p. 281.
‡ *Elec. World*, N.Y., Vol. 28, p. 415.

serted in the space, H, under the platform, P, the tube, R, is excited in one of its two positions for about three minutes to obtain an impression on the plate. Now, without changing the position of the object in the least, the plate-holder in H is removed and a new one inserted with the new plate, and the Crookes tube, R, is changed in position, by lifting the cross piece, T, and setting it on the pins in its other position. Another equivalent exposure is made on the second plate. A single plate-holder may be used, provided the two plates are separated by a lead diaphragm between them where they come back to back, it being only necessary in that case to reverse the plate-holder, but it is safer on account of diffusion of rays to have separate plate holders. The two impressions when developed may be printed in the ordinary way, and the prints obtained therefrom examined by a stereoscope, show the parts of the object in proper relief, provided the displacement of the tube, R, has been such as represents the displacement of the two eyes in viewing the object. For example, if the object be 12 inches away from the tube, R, a displacement of the latter, between each exposure of about 2 inches, will give high relief to the prints, but a less displacement is generally sufficient. Anyone who has examined pictures taken in this way will see at once the value of the method over the ordinary plane or too dimensional picture."

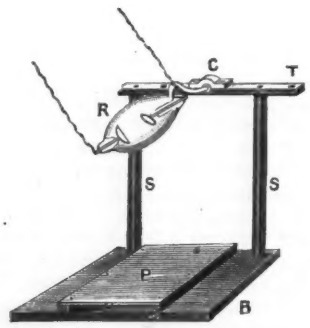


Fig. 5.

It is well known to all who have worked with X ray tubes, that the activity of a moribund tube can be temporarily revived by gently heating it; but the cause of this curious phenomenon is by no means so well understood. Goldstein long ago showed that by heating the cathode, the resistance of a vacuum tube was very considerably reduced, and Prof. S. P. Thompson* has now found that heating the anticathode of a focus tube up to visible redness very decidedly increases the output of Röntgen rays.

For phosphorescent screens no better subtances have yet been discovered than the potassium and barium platinocyanides. Dr. Macintyre considers that the barium salt is better for the examination of the deeper seated structures of the body, since it gives darker shadows; but in most other cases the potassium salt is to be preferred. As the thick layer of these substances usually laid on screens renders large screens very expensive, it is interesting to note that Davies has succeeded in coating an efficient screen of 36 square inches area with 15s. worth of potassium platino-cyanide.

Edison's tungstate of calcium screen appears to be still extensively used in America, and it has at least the advantage of being cheap. Its efficiency appears to depend to a great extent on the method by which the salt is prepared. Ogden† describes how this salt may be made at one-tenth the price at which it is sold by dealers. One ounce each of common salt, tungstate of soda, and chloride of calcium, are mixed and placed in a common crucible. The crucible is fitted with a tin cover and placed in a good coal fire, so as to bring it to a full red heat, at which it is kept for two or three hours, until the contents are fused to a clear liquid. After cooling, the glass-like mass is broken up and thrown into a jar of water, in which the crystals of tungstate of calcium will settle to the bottom.

M. Henry‡ considers his specially prepared zinc sulphide superior to all other substances for X ray screens. The object to be esographed is laid on a sheet of stiff paper which covers the zinc sulphide screen. After a few minutes exposure the screen is taken into a dark room and examined. The smallest details of the image can be studied for at least a quarter of an hour; or for a longer time, if necessary, by gently heating the screen. When this screen is used it would be unnecessary, in most cases, to use the photograph plate, a procedure which has much to recommend it, since it would be less expensive, and would consign the ghastly pictures of our bony skeletons to early and well deserved oblivion.

* *Proc.*, Phy. Soc., Vol. xiv., p. 274.
† *Scientific American*, June 13th.
‡ *C. R.*, 123, No. 8.

IDLE CURRENTS.

In the distribution of electrical energy by alternating currents, perhaps the greatest difficulty to be coped with is the presence of idle or wattless currents; currents which do not in any way contribute to the distribution of energy, but which give evidence of their presence in various ways which are prejudicial to the well working of the central supply station. We have already in our columns* shown that, provided the consumer uses a watt-metre or an erg-metre, the presence of a wattless component of the current is usually a matter of small importance to him so long that the heating effect is not excessive. In a paper read at the Congrès International des Electriciens, Genève, 1896, M. Blondel has taken up the question from the supply companies' point of view. M. Blondel's intimate acquaintance with the properties of alternating current machinery render his remarks of interest to all electricians.

A point to bear in mind is that a power factor numerically less than unity is not the criterion of the presence of a wattless current. A wattless current is a current having the *same periodic time* as the electromotive force, but differing in phase by a quarter of a period. This definition excludes currents of a different periodic time—higher harmonics of the useful current which neither contribute to the energy developed by the useful current, nor have the deleterious effects of the wattless current.

The principal sources of wattless currents are capacity and self-induction. That produced by capacity leads before the impressed E.M.F. by a quarter of a period, whilst that due to self-induction, lags a quarter of a period behind it. M. Blondel asserts that leading wattless currents are of small importance, since their chief drawback is the consequent increased heating of the circuit. He devotes his attention therefore to the lagging component of the current. This, he observes, not only increases the heating of the circuit but also has deleterious effects on the regulation of the generators at the central station.

We differ with M. Blondel on this point. His view is too one sided. In stating that the lagging current is all important, he is disregarding altogether the convenience of the consumer, and considering merely the economy and ease of the conduct of the supply station. We admit that the regulation of the generators is rendered extremely difficult when there is a large lagging current, but we also remember that if there are alternating current synchronous motors on the distributing mains a leading current will interfere with their regulation.

It is known that a lagging current weakens the field of a generater and strengthens the field of a motor, while a leading current has exactly the reverse effect, and the change in the exciting ampere turns has been shown† to be approximately

$$2\sqrt{2}\,i\,n \operatorname{sig} \phi.$$

where i is the virtual current, and n the number of turns on one section of the armature. This expression has to be added to or subtracted from the field ampere turns of a generator according as ϕ is a lead or a lag; and according as ϕ is a lag or a lead in the case of a motor.

It is true that the regulation of the generator is the more important since they have to supply power for lighting purposes as well as for motive power. We not unfrequently

* "The Practical Significance of the Power Factor," Electrical Review, July 3rd, 1896.
† W. G. Rhodes on the "Synchronous Motor," *Philosophical Magazine*, August, 1895.

notice changes of 50 per cent., or more, in the candle-power of incandescent lamps on alternating supply mains; and this variation, be it remembered, is caused by a variation of 7 or 8 volts only on the part of the generator.

If a leading current is of small importance to the generator it is of great importance to any synchronous motor on the circuit. If the current through the armature of a synchronous motor leads before the impressed E.M.F. the field is weakened and the load limit is diminished.

The standard to aim at is to have the current in phase with the generator E.M.F., for unless this is attained both the supply company and the consumer cannot be pleased.

Another point of importance is that if there be machines, or apparatus connected with the mains and possessing either self-induction or capacity, the fall of the potential difference between the mains from the generating station to the centre of distribution will be excessive.

While the inductance of the line is negligible it does not matter, as far as it is concerned, whether the current is in phase with the E.M.F. or not. When, however, there is inductance, a wattless current causes drops of potential which may be very serious.

It is as well to get a correct idea of what fall of potential in an alternating current main really is. It is not, as some believe, merely the product of the current and the impedance of the line, but is the difference between voltage between the mains at the generator end and the voltage between the mains at the distributing end of the line. It is the fall of voltage thus defined that is of practical importance and is generally less than the simple product of the current and the impedance.

To estimate fully the effect of a wattless current on the generators it must be remembered that a generator is not capable of carrying more than a certain amount of current, and that this limit will be reached before it is giving its maximum practical output if the current has a wattless component: that is, unless the current is in phase with the E.M.F. the generator cannot be worked up to its full ability to give power to the external circuit. This is an important consideration since it necessitates a larger generating plant than would otherwise be required.

As alternating current generators have their capacity diminished by a wattless current, so also have alternating current synchronous motors. Induction motors are not so affected. Their rotor bars are usually so stout and their stator windings present so large a cooling surface, that they will stand abnormal currents for a short time and will run quite cool continuously, even if their power factor is as low as 0·5.

To avoid the troubles caused by a wattless current, we must either use apparatus in which a wattless component is not necessary to its working, or else find additional apparatus to counteract the effect.

All alternating current transformers and induction motors demand a magnetising alternating current, and, therefore, necessarily are productive of a wattless component. The proportion of the wattless component to the working component is but small in closed magnetic circuit transformers. In open magnetic circuit transformers and induction motors where there may be considerable magnetic leakage, the proportion is greater, and sometimes so great, that means must, as a matter of economy, be sought to reduce it.

Synchronous motors, if not sufficiently excited, add to the inductance of a circuit, but, if over excited, their effect is the same as that of a condenser and tends to counteract any self-induction in the circuit.

The great advantage of induction motors is that they will start under load with a simple switch arrangement, whereas synchronous motors have to be run mechanically up to synchronism before the load can be put on. This advantage is purchased at the expense of a large wattless component of the current. It is, therefore, advisable to have synchronous motors whenever possible to counteract in part, at least, the noxious effects of induction motors which are to be used when capability of starting under load is the most important consideration.

Another possible remedy suggests itself in the use of condensers placed at the different points in the mains where induction apparatus is placed, so as to be capable of producing the necessary wattless current with a small expenditure of energy. Such means have been tried by several electricians, but apparently without any decided success.

The effects of a lagging current on the generator E.M.F. can be diminished by strongly exciting the field so that the variation of voltage between no load and full load is only 15 or 20 per cent. of the normal value.

It is also possible to suppress the wattless component in motors by placing in the induced circuits apparatus having capacity.

In conclusion, one of the most important problems in electro-technology is the suppression of wattless currents and its noxious effects.

In M. Blondel's opinion the problem admits of solution, and, with him, we think that the solution will be found in possible improvements in the generators and motors themselves. The problem is one of immense importance, and it is to be hoped that before long someone will find the means of producing a good practical motor, self-starting under full load, and possessing a high power factor, and an alternating current generator in which armature reaction is nearly or altogether eliminated.

BRISTOL TOWN COUNCIL AND ELECTRIC TRACTION.

A Committee of the Bristol Town Council has considered the question of electric traction and the attitude that should be taken by the city in relation thereto. Bristol has an extensive system of tramways worked by horses and owned by a go-ahead company. This company a year ago opened a new line to Kingswood, four miles from the centre of the city, working it with great success by electricity supplied on the trolley system, and they have nearly ready for use a second line in which electricity takes the place of horse-power. Both these lines are in the east of the city for both the power would be generated at a station belonging to the company. The Town Council are supplying with considerable success electricity to the citizens, chiefly for lighting, and there is little doubt a contest would ensue whether in future extensions of electric traction in Bristol the Municipality or the company are to supply the current. The Civic Electrical Committee, through their chairman, Mr. George Pearson, has intimated that the Municipality intend to keep the monopoly of electric supply granted to it, although in the case of these eastern tramway lines an exception had been made in favour of the tramway company. The company's representatives have sharply criticised such a claim, and to afford the Civic Electrical Committee and Sanitary Committee material for consideration, the Town Clerk had been instructed to obtain information from various towns, while Mr. Preece had been asked to present a report on the whole subject at issue.

Both these reports came before the Committee. That of Mr. Preece's report, as he stated in its outset, purposed, with regard to tramways, to show: "(1) That their construction, maintenance, and working are the proper function of the municipal authority. (2) That they are best worked by electrical energy. (3) That they are worked more cheaply when they are worked in conjunction with a system of electric lighting." Mr. Preece went first into the general merits of electric traction, touched on its "phenomenal progress" in America, and declared that the Electric Lighting Act of 1882 had "certainly retarded the introduction of tramways into this country, for, as a rule, we are behind other countries, where no such legislation exists, particularly the United States, Sweden, and Germany." The purchase clauses of the Tramways Act he thought had proved very difficult to put into operation, and he commended the special arrangement made in Bristol where concessions had been made to the Tramways Company to bring the whole question to an issue. Examining the merits and demerits of electricity, Mr. Preece stated that the objections were principally æsthetic when the conductors were overhead, but "the eye soon ceases to be æsthetic when general utility comes in, otherwise, we should never quietly submit to the ugliness of lamp-posts." As to the merits of electric traction, Mr. Preece was very eulogistic. But, he proceeded, "however much we may become used to the trolley wire, there are cases of narrow streets and congested traffic, especially in Bristol, where it becomes practically impossible, but with such places there is no difficulty whatever in resorting to an underground conduit, and no objection but that of expense to its adoption. In Hanover, a town of 166,000, and of 49 miles of tramway, an effort has been made to introduce a combined system whereby the central part of the town where the streets are narrow and busy is worked by accumulators, which are charged from the trolley wire from the outside part while the cars are running. 5½ miles of streets are so worked, but the period of working has not yet been long enough to justify the formation of any opinion as to its success." As to combined working of lighting and tramways, Mr. Preece pointed out that the maximum load at a lighting station rarely exceeded three hours duration, and it was impossible to find a better means of increasing the day load than by working tramways, for tramways were fairly regular in their running from 7 a.m. until midnight, with maximum periods in the morning and afternoon as people went to their business and returned therefrom. The experience of Hamburg and other places having been quoted, Mr. Preece declared that it was practical

o work the combined system, and no reason whatever could be adduced against such a divided responsibility (the City supplying the current and the company working the cars) except that of expense and that of a possible failure. In such a system as London where the tramways passed through several municipalities there would be serious difficulties, but in Bristol where the tramways were inaugurated by the corporation, and where the corporation might ultimately decide to absorb the tramways, it appears to him absurd to argue on the other side, for the corporation could supply the current as cheaply as the company could produce it, and still make a profit, for it had the lighting business to relieve it of many of those fixed charges and items of expenditure which the tramway company does not possess. With regard to possible failure of energy, no one for one moment could urge that there was more probability of this happening when the central station is in charge of the corporation officers than when it is in charge of those of the company. Had, Mr. Preece asked, the company in Bristol been more successful than the corporation? The electric lighting installation had been at work since August, 1893, and there never had been a stoppage, yet, moreover, the modern accumulator rendered one independent of machinery breakdown. No one raised the cry of divided responsibility in the case of the supply of water or gas. Would any Tramway Company hesitate to job their horses if they could get them cheap enough.? He contended that tramways were worked more cheaply when worked in conjunction with a system of electric lighting, and that in a place like Bristol, where the lighting was the function of the Corporation policy, economy, and efficiency, showed that the energy for working the tramways should be supplied by the same authority. It must necessarily be so when the tramways became the property and was worked by the Corporation. The arguments used applied solely to the power house, for outside the power house, the mains, apparatus, and staff for electric lighting and tram service must be distinct and separate, and even in the power house, practice, as well as reason indicated that the electrical plant was better distinct for each service. The buildings, the stores, the boilers, the engines, and the management and the staff was common, but with present electrical experience and practice, the electrical plant should be separated. There were now 100 cars for tramway service in Bristol. Suppose that with extensions and the introduction of electricity, they increased to 150. If each car ran 300 days a year, and 70 miles a day, the consumption of energy would be, say, 3,150,000 units per annum. This would mean 4 steam dynamos of 500 H.P. each (including spare power) space for which could, without difficulty, be found on the site for the present Civic Electricity Works. Combined working presented no practical difficulty, and the fixed charges being spread over a much greater output, the cost would be less, and the charge for electric lighting would be reduced in consequence. The report of the Town clerk summarised information received from various parts of the country.

PROCEEDINGS OF SOCIETIES.

Institution of Electrical Engineers.

THE TELEPHONE TRUNK LINE SYSTEM IN GREAT BRITAIN. By J. GAVEY, member. (Paper read November 12th, 1896.)

(*Continued from page* 627.)

OF course, as previously pointed out, the two diagonal circuits in one square are perfectly balanced against one another, and therefore free from mutual disturbance; but in dealing with a large number of telephone loops, if the relative average distance between each of the two wires of any one circuit, say, in the right-hand square, and those of the two wires forming each circuit in the left hand square be measured, it will be found, when all wires have the same twist, either right or left handed, that the average distances between wires of the circuits, the diagonals of which are at right angles to one another, are equal, whilst those that are parallel are not. If one square has a right hand, and the other a left hand twist, then the converse is true, viz, the circuits that are parallel at each pole are balanced, and those that are transverse are not. It is found in practice that disturbances that arise between neighbouring twisted circuits can be eliminated by crossing systematically. Thus, dealing with a number of circuits on one route, the four wires forming the first square may be revolved uniformly throughout. The next four have the A and B wires of each circuit crossed 8 miles from the starting point, and at intervals of 8 miles onwards. The third group have the first cross 4 miles from the former point, then the remainder of the crosses succeed at intervals of 8 miles. The wires of group four are crossed throughout at intervals of 4 miles. Those of group five have the first cross 2 miles from the terminal, then the remainder of the crosses at 4-mile intervals. Group six is crossed at intervals of 2 miles. It will be observed, on examination of fig. 10, which illustrates the arrangement, that each circuit is balanced against all the neighbouring ones; and by this simple method it has been found possible to establish a series of wires absolutely free from overhearing.

Hard drawn copper wire is universally used for trunk lines. Its high conductivity, its freedom from electro-magnetic inertia, its great strength, and its durability, fit it eminently for this class of work. The trunk lines erected by the Post Office vary in gauge from wires weighing 100 lbs. per mile to wires weighing as much as 800 lbs. per mile. The use of such heavy wire as the latter was a subject of much controversy when the present policy of the Department was decided upon, but the results obtained have fully justified the action taken by Mr. Preece. There is, of course, no doubt that with overhead wires pure and simple it would have been quite possible to speak from one end of Great Britain to the other with smaller wires than those actually used for the "back-bone system," but many critics appear to have overlooked the fact that this system was designed with a view to provide for conversation through submarine cables, and through city underground work between London, Belfast, Dublin, and the Continent on the one hand, and the great provincial business centres on the other.

The resistances and the inductive capacity of the various overground wires used in practice are as follows:—

Lbs. per mile.	Resistance. Standard ohms.	Capacity to E.	Capacity, wire to wire.
100	8·782	0·0144	0·00864
150	5·854	0·0147	0·00882
200	4·391	0·0150	0·00900
300	2·929	0·0153	0·00918
400	2·195	0·0156	0·00936
600	1·464	0·0158	0·00948
800	1·098	0·0160	0·00960

It will be observed that with the standard distances at which the wires of a loop are erected in this country the capacity, wire to wire, is 0·6 that of the wire to earth.

The use of underground wires for trunk lines was utterly impracticable, so long as gutta-percha, India-rubber, and other kindred materials only were available for insulating purposes. The introduction of what is practically an air-space cable by the use of paper

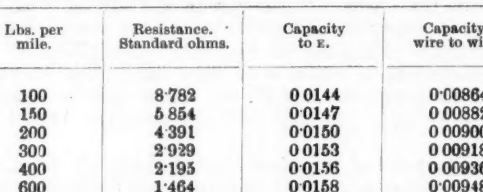


FIG. 10.

insulation appears to offer the solution of a difficulty looming in the immediate future, namely, the finding of space for the numerous wires, both telegraphic and telephonic, which will be required between busy centres. Unfortunately, the need for two wires for each telephone circuit results in the rapid filling up of all aerial supports, and the undesirability of overcrowding poles with wires in a climate like ours, subject to snowstorm interruption, is obvious.

Hitherto the capacity of underground insulators, which roughly equalled 0·3 of a microfarad per mile, seriously limited the use of subterranean conductors. The capacity to earth of paper cables has already been reduced to a figure varying from 0·06 to 0·08 microfarad per mile with small conductors weighing 20 to 40 lbs. per mile. and although these are not well adapted for long trunk circuits, their use for relatively short circuits will soon become general. For heavier conductors, weighing 100 or 150 lbs. per mile, the capacity to earth is about 0·1 microfarad per mile.

The growth of the trunk system of this country. at first slow, has received a remarkable impetus since the Post Office has determined on its present policy.

The first trunk circuit in Great Britain was erected between Cardiff and Newport, and was opened in August, 1881. Shortly afterwards a second loop was erected. Next followed two metallic circuits between Liverpool and Manchester, opened January 27th, 1882, and in May, 1883, two trunk circuits were erected between Newcastle and Sunderland.

The system grew slowly, as the local telephone exchanges increased in size, until the year 1884, when the various telephone companies were authorised to erect trunk wires between any of their exchanges. They then commenced the erection of a trunk wire system which has now been acquired by the State.

At the end of the year 1895, the mileage of telephone trunk wires in Great Britain and Ireland, actually complete or in course of completion, had reached the following figures:—

	Miles.
Post Office system	20,522
National Telephone Company's system ...	28,999
Giving a grand total of	49,521

Further and rapid growth may be confidently expected, so that the present mileage will soon be largely exceeded. Every great town in the country is, or will be, connected with the telephone trunk wires of the State; and it is probably not unsafe to predict that within the course of a few years, practically the whole of the commercial business of the country will be transacted by telephone. In neighbouring manufacturing and commercial districts this condition of things has already been nearly attained.

The method of working the telephone trunk system of the country, with due regard to all the interests at stake, has been a matter of careful consideration on the part of the Post Office Department in conjunction with the responsible officers of the Telephone Company.

The acquisition of the whole of the trunks by the State involved the application of the maxim that "no favour should be shown and no priority given," but that all Her Majesty's subjects, whether subscribers to exchanges controlled by the Department or by private companies, or non-subscribers using call offices, should be placed on an equal footing, and have an equal right to the use of the trunks in the order of application. This involved as a first step the termination of the trunk circuits at the post offices of the towns served—a course which has accordingly been followed. Every such post office is fitted with one or more silence cabinets at the public counter, where communication can be obtained through the switch-room with the trunks serving the town, and through them with any part of the country. Although, however, communication from public silence cabinets, in the manner provided for, is at times of considerable convenience to individuals, the vast mass of the telephone trunk traffic must obviously emanate from and be for subscribers permanently connected with local exchanges; and accordingly the important problem which had to be solved was the working out of a system that would provide for establishing the most facile and rapid means of communication between the trunk circuits of the Postmaster-General and the subscribers to local exchanges, whether those of the Post Office itself or of the company. As the majority of the local exchanges are situated in the company's buildings, at a distance from the respective post offices, it would at first sight appear as though the concentration of the trunk circuits in the latter would introduce undesirable delay in manipulation; but on examination of the problem it becomes evident that this is not necessarily the case. At all large offices the separation of the trunk system from the local switch was long ago effected; and although the local subscribers' wires were generally multiplied on the trunk switchboard, a subscriber's request for trunk line service was necessarily first communicated to the operator in charge of the local section, and, as it was impossible to arrange for every such local operator to have direct access to the trunk circuits, the request had to be conveyed by telephone to a recording operator, who first registered the want, after which the ticket containing the details was passed by a collector to the trunk operator in charge of the particular circuit wanted. Thus, whether, as was usually the case at the company's offices, the trunk switch was in the same room as the local switch, or, as occasionally happened, in an adjoining one, the same number of operations would be necessary in either case. Now, instead of the trunk switch being in the adjoining room, it is in another building in a neighbouring street, and, so far as the actual mode of transmitting information as to a subscriber's requirements is concerned, the operations are the same in number and character in both cases.

The general system adopted is as follows:—All the trunk circuits are terminated at the respective post offices. Connection between the trunk and the local subscribers' switches is established by means of "junction circuits." For each trunk circuit one junction is provided to the local post office switch, and one to the company's principal exchange switch. These junctions are used solely for switching.

For conveying instructions, call or service circuits are established in the ratio of two circuits to each local switch for every 20 or less number of trunks. Half these circuits, known as "up" call circuits, connect the local switches with the recording tables, and they terminate in head-gear telephones, which are worn continuously by the ticket operators. The other half, known as "down" call circuits, serve to connect successive groups of 20 trunk jacks direct with the switches of the local subscribers, and they likewise terminate in headgear telephones.

At the smaller offices, where a few trunk circuits only exist and the traffic is but slight, the call wires are fitted with indicators; and at the larger offices the call wires are terminated on indicators during the slack periods, as it would obviously be absurd to retain an operator listening continuously for a few intermittent calls.

The method of working is, briefly, as follows:—A demand for a trunk call is conveyed to the local switch operator; the latter at once, without initiatory ring or signal, transmits the request to the recording operator, who enters the particulars on a ticket, which is then timed in telegraphic code and sent to the trunk section affected. It may thus be said that a local subscriber's want is immediately made known to the trunk operator at the neighbouring post office; although the actual time of putting through and the commencement of conversation depend, of course, on the number of prior calls, and the time lost in obtaining the distant subscriber's attention.

When the call matures—*i.e.*, when the trunk circuit is free, or previous calls have been disposed of—the trunk operators at each extremity come in on the "down" call circuits, and request the junction operators to join specified junctions through to the subscribers who are wanted. This done, the trunk operators then ring up the subscribers, and on receiving replies they connect them direct to the trunk circuit.

Stripped of all technicalities, the method of working is, briefly, as follows:—

A subscriber, say 100, in a town "A," wishes to communicate with one, No. 200, in a town "B."

The former calls his local exchange, and expresses his wish to the local operator, then hangs up his telephone. This request is at once transmitted on the "up" call wire to the ticket operator at the post office, where it is recorded on a white numbered ticket, which is timed and placed on the trunk switch.

In proper turn with others the ticket is dealt with thus:—The trunk operator at "A" transmits the request to the trunk operator at "B," who enters details on a pink ticket. The "A" trunk operator then comes in circuit on the "down" call wire, and asks the junction operator to connect subscriber 100 to junction, say 4, at the same time inserting the necessary pegs in junction 4 and in the trunk. The junction operator ascertains in the usual manner if the subscriber is disengaged, and, if so, she makes the necessary connection, advising the Post Office operator of the fact on the selected junction circuit. The latter then rings up subscriber 100, and tells him he is through to 200. At the same time the trunk operator at "B" is getting through to and calling 200 in a similar manner, and when both subscribers answer their calls they find themselves in communication with one another. Although the detailed description of the operations may appear complicated, the facilities for communication between the trunk and the junction operators are such that the brief instructions that are necessary are conveyed in a few seconds, and the loss of time in manipulation by skilled operators is insignificant.

The above describes the ideal condition of things. Unfortunately, in many cases, subscribers fix their telephones in out-of-the-way localities, and leave them in charge of office boys, who frequently regard them as toys rather than as a serious means of effecting important correspondence. In these cases the attention given is often bad, much time is wasted in ringing even before an answer is obtained, and more time is lost in fetching a responsible person to the instrument to deal with the matter in hand. In the meantime one of the subscribers is probably standing at his telephone unconscious of the cause of delay, but anathematising the Post Office, the Telephone Company, and all connected therewith, and not unfrequently he concludes with a series of bitter complaints addressed to the local Press.

The obvious remedy for this undesirable state of things is for firms who have a considerable amount of telephone correspondence to provide two or more local connections, one of which should be rigidly reserved for trunk work. The telephone in connection with the latter should be fitted in the office of a responsible member of the firm.

In designing the apparatus necessary for working the Department's trunk circuits in accordance with the foregoing principles, innumerable matters of detail had necessarily to be considered, amongst the more important being the following:—

1. The capacity of the separate sections of a trunk switch, and the provision for growth and extension at each office.
2. The working capacity of the operators—*i.e.*, the number of trunk circuits each could manipulate satisfactorily and without delay during the busiest periods of a working day.
3. The signalling and calling arrangements both for trunk and junction circuits.
4. Facilities for through trunking, *i.e.*, connecting two or more trunk circuits at intermediate offices to provide communication between towns not directly connected.
5. General details of switch and transfer on through trunking sections.

(To be continued.)

The Northern Society of Electrical Engineers.

On Cheap Steam Power. By J. S. Raworth, member. (Paper read November 10th, 1896.)

(*Concluded from page* 649.)

It is unfortunately extremely difficult to find examples of the steam consumption of first-class engines, except Willans' working non-condensing; in fact, the only one I have been able to find is Mr. Hammond's test at the Leeds station of a Corliss engine by Messrs. Hick, Hargreaves & Co. The indicated horse-power was 405, and the steam used per I.H.P. 20·31 lbs. The theoretical consumption was probably about 16¼ lbs.

It is worthy of remark that the consumption obtained in this trial coincides as nearly as possible with Willans' results under apparently similar conditions.

The above-mentioned results obtained with a very diminutive Universal engine, combined with the structural advantages described under the heads, *a*, *b*, *c* and *d*, above, all tending to increase economy, do, I believe, justify the expectation that this steam cycle, and the means whereby it is obtained, will, when applied to large engines, effect a very considerable saving of steam.

It now remains for us to consider whether the cost will be increased or diminished. I say unreservedly "diminished." Assume for one moment that the cylinders be applied to any existing design of compound Corliss engine.

The first result is to reduce the number of valves from eight to four, and of valve boxes from four to two.

The high pressure cylinder and piston cost no more than the present tail rod and guide, and at the same time the cost of the low pressure piston and cylinder is reduced, whilst lagging, cylinder cocks, and other trimmings, come down from pounds to shillings. This is the least effective case; all we can say for it is that it will be in some degree both better and cheaper.

Now take the triple expansion engine, in which there is an acknowledged saving in steam of about 12 per cent., at similar pressures. This, however, in a Corliss engine involves 4 cylinders, 8 valve boxes, and 16 valves, with other gear to match—but with the Universal cycle there are still only 2 valve boxes and 4 valves—in fact the triple engine is distinctly more simple in construction than the 2 crank compound, and can be made for the same price. The saving in the cost of a triple expansion engine would, therefore, obviously be very considerable.

There is yet one step more—shorten the stroke and make the engine vertical—that is, if you like; if you don't like, don't; rest satisfied with the advantages aforesaid.

But there are further advantages to be gained by short stroke and vertical position.

1. No loss of economy as heretofore.
2. No unequal wear of cylinder.
3. Perfect lubrication by simple means.
4. Increased mechanical efficiency.
5. Reduced cost of engine.
6. Reduced cost of foundations and buildings.
7. Greater facility of repair.
8. Reduced cost of fly-wheel and gearing.

Every item of cost reduced and with a possible or rather probable saving of steam, with the triple engine a certain saving.

Now we turn to our original tables of costs and substitute the following figures, which I leave to your intelligent criticism.

EXAMPLE No. 1.—COTTON MILL.

1,000 H.P. Universal.

Total capital expenditure £7,000.

(a)	Coal at 1¾ lbs. per I H.P. and 10s. per ton ...	£950
(b)	Labour	225
(c)	Maintenance	150
(d)	10 per cent. on £7,000	700
(e)	... ...	£2,025

0·2d. per H.P. hour, saving 20 per cent. = £552.

EXAMPLE No. 2.—ELECTRIC.

1,000 H.P. CORLISS.

Total capital expenditure on steam power only, £10,000

(a)	Coal at 3lb. per I.H.P., and 10s. per ton ...	£334	0	0
(b)	Labour	250	0	0
(c)	Maintenance	300	0	0
(d)	10 per cent. on £10,000	1,000	0	0
		£1,884	0	0

0·9d. per H.P. hour, saving 37½ per cent. = £1,136.

Having now dealt with the cost of steam power in two well-defined cases, both being on a comparatively large scale, it is desirable to revert for a few moments to the statement made in the opening of the paper, namely, that there are more small engines than large ones, and that they take more than their share of the coal bill of the country, my opinion is that any measure of reform in steam practice, to be in any sense universal in its operation, must be applicable to small engines as well as large ones.

Last year Mr. Lindley said on this subject: "It would not have been difficult to make small copies of the slow speed mill engine." This statement may be perfectly true in the abstract, but the practical difficulties surrounding it are commercially prohibitive.

The fact remains that all small steam engines at present in use up to about 50 horse-power are decidedly wasteful, and from that power up to 100 H P. they are much less economical than the Lancashire mill engine.

The Willans engine is an exception to the general rule, but sundry considerations have militated against its general adoption for ordinary industrial purposes.

Take the case of a 40 horse-power engine driving a mechanic's shop, with, say, a 12-inch cylinder by 20-inch stroke running at 120 revolutions, or with a 10-inch stroke at 240 revolutions. With an average load of 25 horse-power the steam consumption per horse-power is usually at least 50 lbs. per horse-power hour.

It is not possible to arrive at the total cost of power with anything approaching the accuracy of the former instances, but it may be approximately estimated as follows:—

EXAMPLE No. 3.

40 H.P. ENGINE.

Average load 25 H.P., 54 hours per week.

LOAD FACTOR.

$$\frac{2808}{8760} \times \frac{25}{40} = 19{\cdot}2 \text{ per cent.}$$

H.P. hours = 70,200.

Total capital expenditure, £400.

(a)	Coal 7 lb. per I.H.P. and 10s. a ton. ...	£110	0	0
(b)	Labour, at 26s.	67	10	0
(c)	Maintenance	30	0	0
(d) (e)	10 per cent. on £400...	40	0	0
		£247	10	0

= 0·84 per H.P. hour.

Assume now that a similar installation be made with an engine of the Universal type. The only saving in prime cost would be in the boiler, which would be reduced to half the size of the former.

40 H.P. UNIVERSAL.

	Total capital expenditure	£360	0	0
	H.P. hours, 70,200			
(a)	Coal at 3 lbs. I.H.P. and 10s. a ton ...	47	5	0
(b)	Labour	67	10	0
(c)	Maintenance	20	0	0
(d) (e)	10 per cent. on £360	36	0	0
		£170	15	0

= 0·58d. per H.P. hour = saving = £76 15s. 0d.

It will be noticed that the sum saved, though only a small fraction of a million, is enough to maintain one working man and his family, or, from another point of view, it is equal to the interest on £2,800 of consols. From another point of view the saving alone would pay for the whole installation in 4½ years.

The conditions which prevail in the last example quoted are, in some respects, similar to those which so severely worry the brains of the chief of our electric supply stations, namely, variable load with an average much below the maximum. It is in cases of this kind that the advantages of automatic expansion show themselves more decidedly than with a steady load, as for instance, in a cotton mill.

Probably the best exposition of this subject is contained in Captain Sankey's paper on the "Governing of Steam Engines," read before the Institution of Mechanical Engineers in 1895.

In that paper Captain Sankey shows curves of the total water consumption with automatic expansion as calculated, and as obtained in practice, and both compared with the Willans straight line diagram.

The conclusions he arrives at are as follows:—

1st. That the theoretical gain by automatic expansion is less for high pressure than for low.

2nd. That the gain is less in practice than in theory.

3rd. That as the mean pressure is reduced, a point is reached below which the consumption is greater with automatic expansion than with throttling, and that for 150 lbs. initial pressure this point corresponds with a mean pressure of 14 lbs.

In the diagram on the wall, I have plotted the results of three tests made under nearly identical conditions; the upper or straight line is taken from Willans non-condensing trials; it is a constant expansion curve. The second short curve is from the same engine with varied expansion. The third and lowest curve is from a Universal engine of the same stroke as the Willans, but with a 14½ inch L.P. cylinder in place of 14 inches.

It will be observed that whereas the middle curve, if produced downward, would cut the straight line at the point marked "A," representing 20 H.P., the lower curve never cuts it, and, therefore, maintains superior economy over the constant expansion to the last.

This is due to the fact that the automatic shaft governor at light loads not only cuts off early, but also throttles the steam, thus reducing the range of temperature within the cylinders.

The main practical result is, therefore, that the Universal engine fitted with the shaft governor is at all loads more economical than a throttled engine, and that from half load to full load the consumption per I.H.P. is nearly constant.

The saving in the cost and worry of working an electric lighting plant will be so obvious to all that I need not further enlarge upon it.

Having now given you my views on the subject of cheap steam power, illustrated by examples, which at best are only comparative, for in the nature of the case it is obviously impossible to select an example of each class that would be accepted by all engineers as a correct average; and having indicated one method by which I believe the cost of steam power may be reduced to some extent at least with every existing class of steam engine, and particularly with the high speed vertical, I desire, in conclusion, to offer my humble tribute of admiration and of obligation to the memory of the late Peter William Willans. Not only did he give us clear and practical expositions of the theory of the steam engine, but he also gave us experimental data so varied and so voluminous, that in his "steam engine trials," "condensing and non-condensing," one may find an example to fit almost every case.

Probably the most important feature of those trials is, the fact that they were made on the same engine, in which, without doubt, the leakage was very small, but whatever it was the conditions remained practically constant throughout.

Ordinary engine trials made on different and dissimilar engines are often extremely misleading; for many a well designed engine fails to do justice to itself simply because the valves and pistons accidentally allow steam to pass. Thus the good points of the general design are beclouded.

There is another aspect of Mr. Willans's work which I think has not received sufficient recognition, namely, that he demonstrated that short stroke did not necessarily involve, as it was then believed to involve, either mechanical loss of power or loss of thermal efficiency, in fact, he obtained results with an unjacketed engine of 6-in. stroke and 14-in. low pressure cylinder which are difficult to beat in any size or any design of steam engine. These results, although they are much better than those usually guaranteed to purchasers of Willans engines, were, I firmly believe, fairly and honestly obtained, and they have done more to stimulate and encourage the engineering profession than anything that has been done or said in my time.

Although I am much indebted to Willans, I am more so to Corliss, for without the Corliss valve, the Universal engine, if it could exist at all, would be but a mere makeshift; the very essence of its economy would be absent.

Physical Society.

ORDINARY MEETING, NOVEMBER 13TH, 1896.

Captain ABNEY, President, in the Chair.

A paper on SOME EXPERIMENTS WITH RÖNTGEN'S RADIATION, by *Prof.* THRELFALL and Mr. POLLOCK, was, in the absence of the authors, read by the SECRETARY.

The authors describe a form of Crookes tube which, while it can be made by any one capable of the most elementary glass blowing, gives a plentiful supply of Röntgen rays. The results of their experiments may be summed up as follows:—

1. The Röntgen radiation does not consist in the projection of gaseous matter, or if it does, the amount of such matter involved is extraordinarily small.

2. The Röntgen radiation does not consist in the projection of ether streamers having a velocity above a couple of hundred metres per second; this is true, whether the radiation takes place in air or in benzine.

3. The properties of the ether regarded as determining the velocity of electro-magnetic waves are not greatly changed (*i.e.*, not at all within our experimental limits) by the Röntgen radiation, and this applies alike to the ether in air and in benzine.

4. A selenium cell composed of platinum electrodes and highly purified selenium is affected by Röntgen radiation to an extent which is comparable with the effect produced by diffused daylight.

5. No permanent or temporary electromotive force is set up in a selenium cell by the Röntgen radiation.

The authors have come to the conclusion (1) by exposing an exhausted tube placed in parallel with a spark-gap, so adjusted that the spark just passes over the gap rather than through the tube, to the Röntgen radiations. They find that a vacuum tube in parallel with a spark gap is very sensitive to changes in pressure within the tube. Conclusions 2 and 3 were arrived at by using Michelson's arrangements for the interference of two beams of light.

Mr. Shelford Bidwell said he had made some experiments on the effect of Röntgen rays on the resistance of selenium, but with a negative result, although he could have detected a much smaller change than that found by the authors. It might be that this difference was due to the tube, for in his experiment the radiation started from a platinum plate within the tube, while in the authors' arrangement the radiation starts from where the cathode rays strike the glass of the tube.

Prof. Silvanus Thompson said there were a number of points with reference to the Röntgen radiation which required clearing up. For instance, the suggestion that they were vortices in the ether had not been tested. Again, Lafay says that if the rays are passed through a metal screen which is charged with electricity, then the rays can be deflected by a magnet. He (Prof. Thompson) had not been able to repeat this experiment, neither had he that of Galitzine on the polarisation of the rays by tourmaline. The statement of Prof. J. J. Thomson that under the influence of the radiation paraffin became a conductor, had not been satisfactorily proved. As to the wave length, while some observers obtained values about one-tenth that of the extreme violet, another had obtained a value greater than that of the extreme red. He (the speaker) did not understand the authors' device for detecting changes in the vacuum of a tube, since everyone who has worked with Crookes tubes has found that the resistance is always greater for a spark in one direction than the other, and also varies with the battery power employed. Lenard, adopting Hertz's arrangement, uses as anode a cylinder surrounding the cathode (a disc), the id a being that by using such a symmetrical arrangement, the cathode radiation was more homogeneous. It might be advisable, when seeking to produce homogeneous Röntgen rays, to adopt such a symmetrical arrangement.

The Chairman said that since no selection was made with reference to the announcements which appeared in the *Comptes Rendus*, it was frequently found that these announcements were wrong.

Mr. Bryan then read a paper by himself and Dr. Barton, On the Absorption of Electrical Waves along Wires by a Terminal Bridge.

The authors employ for the generation of the oscillations an arrangement of the same description as that used by Bjerknes, the waves being propagated along two parallel wires about 116 m. long. In order to measure the waves they use a small electrometer with an uncharged needle. The resistances employed to form the bridge consist of pencil marks on ground glass. Bridges of three resistances have been examined, one having as nearly as may be the resistance necessary, according to Heaviside's theory, to give complete extinction of the reflected wave, and of the others one was of higher and the other of lower resistance. In each case the results confirm the theory, and it is thus experimentally proved that by using a bridge of this description the reflected train of waves can be completely extinguished.

Mr. Blakesley asked if the authors had made any allowance for the capacity of the wires.

Mr. Campbell asked if the resistances given were expressed in ohms or in electro-magnetic units.

Mr. Bidwell asked if the authors had found that the pencil trace resistances obeyed Ohm's law. He had found that if you balanced with one cell in the battery circuit, then on increasing the battery power to two cells, the resistance altered.

Mr. Appleyard suggested that the variation was caused by the contacts at the ends not being good.

Mr. Campbell said the same variation occurred in the case of mixtures of clay and plumbago, where the contacts were quite good.

Mr. Carter suggested electroplating the ends, to give good contact.

Mr. Bryan, in his reply, said that they had not considered the question of capacity, and that in their case they did not require to know the resistance very accurately.

The Society then adjourned till November 27th.

INTERNATIONAL TELEGRAPH CONFERENCE AT BUDA PESTH.

[*Translated from the Journal Télégraphique, November*, 1896.]

(*Continued from page* 545.)

Transmission of Telegrams (Articles 32—46).

No important change has been made in the rules affecting the transmission and receipt of telegrams, excepting in the manner in which they are to be written.

The propositions were considered, but the Conference was not willing to alter existing rules which have been in use for a long period, and have not up to the present caused any serious inconvenience.

It was thought prudent, and so decided at the Paris Conference, that the name of the delivery office should be transmitted in the preamble, excepting in the case where two offices directly communicate, and then only in an abbreviated form. This was put into practice, and resulted in so many errors of transmission and claims for refunds, that most of the offices declared themselves willing to revert to the old system.

The Conference conceding, altered the wording of paragraph 1 *b* of Article 37, which now stipulates that the name of the delivery office may only be omitted in the preamble of messages where the offices of origin and destination are in direct communication.

Letter "*e*" of the same paragraph contains a very important innovation for the service.

To prevent frequent annoyance arising from the difference between the actual and chargeable number of words, it has been decided to indicate them in the form of a fraction, of which the numerator represents the number of words chargeable, and the denominator the actual number of words.

Further, letter "*g*" has been amplified, and provides for the indication of the route prescribed by the senders of a telegram in the preamble, so long as it is of use for the routing of such message.

This does not refer to "reply paid," or "acknowledgment of receipt" messages, which must bear the indication of the route until they reach the office of destination.

Delivery at Destination (Articles 47 and 48).

Only a few alterations in the wording have been made.

Special Telegrams (Articles 49—64).

The Conference has made some new regulations, which are of interest to the public, *e.g.*

As far as telegrams with "reply paid" are concerned, the new regulation allows the receiver of such a message to use the draft at any branch office at the destination. Up to the present a draft could only be handed in at the office which sent the telegram out for delivery.

As at present, the sender may demand by telegram or post information as to the date and hour at which a telegram has been delivered.

In the former case a sum must be deposited for the acknowledgment of receipt, equal to the charge for an ordinary telegram of 10 words to the same destination and by the same route. In the latter case a fixed charge of 50 centimes will be made.

An acknowledgment of receipt by post must contain the same particulars as would be given in an acknowledgment of receipt by telegraph. It is sent in a stamped registered envelope by the office of destination to the office of origin, which immediately advises the sender.

A demand may be made that telegrams arriving within the delivery district of an office be re-transmitted to another district, and under certain conditions the receiver may pay the cost of such re-transmission in advance.

Such telegrams may be made "urgent" by the payment of three times the cost of re-transmission.

"Telegrams to follow" can be re-transmitted beyond Europe, but it is optional for the offices in the extra-European system.

As regards "multiple telegrams," that is to say, telegrams addressed to several names or the same name at different addresses, the Conference has authorised a charge of 1 franc per copy to be collected when such telegrams are marked "urgent" by the sender.

Charges on telegrams addressed to places not connected by international telegraph for forwarding should be recovered from the receiver, but a new regulation introduced at Article 60 permits senders to prepay these charges by making a deposit. If the sum deposited is insufficient to meet them, the difference will be collected from the sender. Any surplus is, however, retained by the administration.

The information may be obtained by telegram to the delivery office, by the same route, of 5 words, or a sum equal to 50 centimes may be deposited.

To cover all charges, a sum fixed by the sending office must be deposited, and this sum will be remitted to the delivery office after receipt of the information.

Charges fixed by the delivery office are to be collected from the sender.

Further, the charge for forwarding telegrams by post or ship to a country other than that to which the telegram is addressed is in all cases 50 centimes.

To avoid telegraph money orders being delivered so much later than ordinary telegrams, a new regulation has been added to Article 65, which ensures the delivery of an advice to the payee immediately the telegram has been received.

The regulations referring to the "Telephonic Service" and to "Records" remain unaltered, and we now pass to the parts dealing with "Deductions" and "Refunds" (Articles 70—73).

The Conference has made at Article 70 the following provisions:—

For extra European correspondence addressed to countries of the European system, the time limit within which a refund must be made has been reduced from 48 to 24 hours; but the time limit of 48 hours has been maintained for countries of the European system which do not belong to Europe.

In all cases sums paid for special service instructions which have not been carried out, or amounts paid for services to correct service errors are refunded without reserve.

In "Reply Paid" messages, the form for the reply is available for

six weeks. If it is allowed to lapse, the sender can obtain a refund of the amount paid for the reply on condition that the form is given in before the expiration of three months from the date of its issue.

Finally, in paragraph 5, all refunds for "Rectifying Telegrams" are refused, unless they are sent through the offices in the form of paid service advices.

According to the Paris regulations, claims for refunds in the international system of Europe have to be made before the expiration of two months; in the extra-European system they must be made within six months. In the former case the Conference has increased the time limit to three months.

It was also decided at the Conference to allow administrations on the presentation of a claim for a refund, to collect a fee amounting in the European system to 50 centimes, and in the extra-European system to 2 francs.

If it has been decided to make a refund, these charges must be given to the claimant by the office of origin, together with the cost of the telegram.

The fee is required to indemnify administrations against losses arising from investigating improper claims.

Accounts (Articles 74—78).

These have been very satisfactorily treated by the Conference.

Accounts have not been simplified as much as could be desired, especially in the European system, but at any rate the Conference has freed them from numerous details, which made the accounts very difficult and complicated.

In making up international accounts of the European system, it is only necessary to enter the charges of the number of words transmitted (counting every word of an "urgent" telegram as three), and those of prepaid replies, as amounts collected for special instructions, are retained by the office which collects them, and therefore are not taken into account.

This will simplify matters considerably.

It is very desirable that this simplification should also be made on the extra-European system, but it would be difficult to carry it out by reason of the sums in question being very often considerable, and companies and administrations could not afford to neglect them. It has, however, been decided that charges for copies and forwarding beyond telegraph lines by quicker means than the post, should be handed to the administration which delivers such copies or pays the forwarding charges.

As regards sums collected for "Acknowledgments of receipt," they are to be paid to the office of destination, and therefore must continue to appear in accounts.

With reference to the payment of accounts, a regulation has been added to paragraph 4, of Article 78, which authorises the charging of 5 per cent. interest by all offices on accounts of administrations which are not settled within six weeks; such interest to be charged from the day of expiration. This is to indemnify administrations against losses arising from late settlements of accounts.

Articles 79—87 referring to Reservations, the Bureau International, Conferences, and Relations with non-adhering offices, remain practically unchanged.

The alterations are not sufficiently important to record.

Tariffs.

Very little has been done with the existing rates of the European system.

Great Britain has made reductions on the Spanish, Portuguese, Gibraltar and Morocco traffic, and has also reduced rates between Gibralter and Scandinavia.

According to an arrangement between the administrations and the interested companies, a uniform rate of 35 centimes a word has been fixed for telegrams between the United Kingdom and Spain, Portugal and Gibraltar.

Germany, and the Great Northern Telegraph Company, have reduced their transit charges by 4 centimes for correspondence between Scandinavia and France, Spain, Portugal, Canary Islands, Algeria, Tunis and Gibraltar, as well as for telegrams exchanged between Denmark and Russia.

We have further to record a reduction of rates in the European system between Italy and Roumania and the latter country and Spain.

Finally, as the Conference was about to disperse, the Eastern Telegraph Company announced a reduction of their rates for correspondence between Europe and Tripoli, amounting, on an average, to 50 centimes a word.

The most important changes have been made in the extra European system.

The extra European offices, the Great Northern Telegraph Company, and the companies owning connecting cables to Africa, East Indies, and the far East, have decided, in view of the demand of the public, either from the present or at some future time to reduce and make uniform charges.

The rate between Europe, China, and the Japanese frontier, *viâ* Vladivostock, will be reduced as follows:—

Europe to China from fr. 8.50 to 7 francs. (This includes the Chinese terminal rate.)

Europe to Japanese frontier from fr. 8.50 to 7 francs. (This does not include the Japanese terminal rate, which is reduced from 85 to 70 centimes a word.)

This reduction was obtained by reason of representations of Russia. The latter country has also reduced its transit rate for telegrams to the far East from 3 francs to fr. 2.25 a word, to commence from July 1st, 1897.

The Eastern and Eastern Extension Telegraph Companies have proposed considerable reductions of rates between Europe and countries beyond India, *viâ* the "Eastern" or "Russia," viz.:—

Malacca	from fr.	6.95	to. fr. 6.275
Singapore	„	7.20	„ 6.275
Labuan	„	8.	„ 6.275
Hong Kong and China	„	8.50	„ 7.
Macao	„	9.	„ 7.25
Japan	„	13.35	„ 10.70
Java	„	7.45	„ 6.275
Sumatra and the Celebes Islands	„	8.10	„ 6.775

The same companies have reduced the rates between Europe and Cochin China, Annam, and Tonkin, to fr. 5.60 a word.

They also propose to reduce rates on their lines to countries further East.

As regards Africa, a uniform rate of fr. 6.25 has now been fixed between Europe, the Seychelles, and Mauritius, and other considerable reductions have also been made between India, countries beyond, and East Africa, including the Seychelles and Mauritius.

In conclusion, we have to notify the reduction of the terminal rates of Russia for correspondence from the Russian frontier in Europe, the Caucasus, and Vladivostock; also Persian reductions of terminal rates; and lastly, the reduction of British India transit rates for telegrams passing (1) *viâ* Bombay, Madras, and Kurrachee; (2) those passing the Chinese frontier *viâ* Bhamo, or the Siamese frontier *viâ* Moulmein, from fr. 1.50 to 75 centimes.

NEW PATENTS.

NEW PATENTS.—1896.

[*Compiled expressly for this journal by* W. P. Thompson & Co., *Electrical Patent Agents*, 322, *High Holborn*, *London*, *W.C.*, *to whom all inquiries should be addressed.*]

24,381. "Improvements in electric switches." M. B. Cotterell and H. Russell. Dated November 2nd.

24,413. "An improved handfeed electric arc lamp." A. G. Smith. Dated November 2nd.

24,472. "Improvements in and connected with frames for electric accumulators." H. Leitner. Dated November 2nd.

24,473. "Improvements in and connected with primary and secondary galvanic elements." H. Leitner. Dated November 2nd.

24,475. "Improvements in and relating to plate carriers for secondary batteries." H. Leitner. Dated November 2nd.

24,481. "Improvements in casings for electric conductors." H. Reason. Dated November 2nd.

24,548. "An improved automatic safety device for electric circuits." L. G. Rowand. Dated November 3rd. (*Complete.*)

24,551. "Improvements in electric railways." H. C. Reagan, Jun. Dated November 3rd. (*Complete.*)

24,554. "An improved way of connecting electrical fittings." R. C. Jeboult. Dated November 3rd.

24,574. "Improvements in microphones." T. J. Howell. Dated November 3rd.

24,577. "Improvements in the preparation of filaments for electric lamps." J. H. Douglas-Willan. Dated November 3rd.

24,766. "New and improved switches for electric currents." W. R. Rawlings and J. J. Rawlings. Dated November 5th.

24,783. "Improvements in connection with submarine cables for forming electric communications between light-ships and the shore, also applicable for other purposes." J. G. Browne. Dated November 5th.

24,897. "An improved pneumatic-electric relay for organ mechanism." G. F. Weigle. Dated November 6th.

24,910. "Improvements in brushes for dynamo-electric machines." P. J. C. Carron. Dated November 6th.

24,924. "Improvements in electrically operated cloth cutters." G. P. Eastman. Dated November 6th.

24,947. "Improvements in and connected with electric arc lamps." A. L. Davis. Dated November 7th.

25,001. "Improvements in electric lighting apparatus for cabs and other carriages." Headland's Patent Electric Storage Battery Co., Ltd., and H. W. Headland. Dated November 7th. (*Complete.*)

25,030. "Improvements relating to the regulation of electricity meters." P. Wilson. Dated November 7th.

25,036. "Improvements in or connected with electric batteries." J. L. Dobell. Dated November 7th.